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HENRY O'MALLEY, Commissioner

FISHERIES OF KEY WEST AND THE CLAM INDUSTRY OF SOUTHERN FLORIDA

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APPENDIX XII TO THE REPORT OF THE U. S. COMMISSIONER OF FISHERIES FOR 1923

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FIG. 1.—A part of the Key West fleet which fishes the near-by reefs for small bottom fish. On the dock can be seen the type of slat live car that is used to retain the surplus catch of live fish.

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CONTENTS.

	Page.
Key West fisheries	1
Smaller reef fishes	2
Larger reef fishes	3
Annotated list of commercial food fishes found in the vicinity of Key West	4
Mullet fishery	35
Kingfish fishery	38
Spanish-mackerel fishery	40
Spiny-lobster fishery	43
Stone crab	49
Turtle fishery	50
Sponge fishery	54
Florida conch	59
Clam industry of southern Florida	59
Bibliography	68

KEY WEST FISHERIES.

Key West was settled in 1822, and from the very beginning of its existence fishing formed one of its principal industries. At the present time fishing is, perhaps, of first importance to the inhabitants, although in value of output it is exceeded by the cigar industry.

The fishermen's equipment and their methods of fishing and disposing of their catches are practically the same to-day as they were 40 or 50 years ago. Indeed, many of the small fishing boats now in use are at least 40 years old. The only fisheries which have shown noteworthy developments during the last half century are those of the spiny lobster and the Spanish mackerel.

The Bureau of Fisheries' statistical canvas of 1918 shows that 458 persons were engaged in the fisheries of Monroe County at that time, and nearly all of these were credited to Key West. This number is considerably augmented in winter, however, during the height of the mackerel and kingfish season. In 1918 fishing vessels not engaged in shore fishing, together with outfits and various apparatus, were valued at $38,435; transporting vessels with their outfits at $14,450; 311 sailboats, power boats, and rowboats, together with various equipment and apparatus, at $80,837; and shore and accessory property amounted to $56,287 in value—a grand total of $190,009. The

[1] Appendix XII to the Report of the U. S. Commissioner of Fisheries for 1923. B. F. Doc. No. 962.

various fishery products credited to Monroe County in 1918 totaled 3,752,355 pounds, which represented a first value to the fishermen of $290,170.

Most of the wholesale trade in fish is carried on from November to April, when perhaps 90 per cent of the annual catch of fish is taken. Several dealers operate during the entire year, but others are actively engaged in Key West only during the winter. Dealers in sponges and turtles operate throughout the year. All the wholesaling is done with dealers outside the city.

It was not until 1920 that an ice-making and cold-storage plant was built to take care of excess catches of fish. Previous to that time, notably early in 1919, the fishing industry suffered severe losses when the one small ice-making plant in the city became disabled.

The retail fish trade is taken care of at the wharves, where the fishermen keep their catches alive in boat wells or in live cars, selling direct to the consumer. There are no local retail stores that sell fish, but small quantities are peddled in pushcarts throughout the city. A person desiring to buy fish goes to the wharves, looks over the stock in the various live cars, and selects the fish he wants. The fisherman then removes the fish selected from the live car with a dip net and cleans and strings them without severing their heads. This method of keeping fish is especially desirable in such a warm climate, as it eliminates icing and insures fresh fish at all times. The variety of fish sold in Key West is probably greater than in any other locality in the United States. A string of fish as sold at the fish wharves usually consists of from 2 to 4 species, but if one so desired one would have no difficulty in buying a string containing 20 fish of different kinds.

The fishing fleet is composed mainly of small boats, some of which are equipped with sails only, some with gasoline engines, and some with a combination of the two. These boats seldom travel far from land and are used chiefly in fishing on near-by reefs, which are numerous about Key West. Very few boats of the larger and better type are owned locally, but a number of such vessels come from the east and west coasts of Florida to fish at Key West during the winter.

The most important products of the Key West fisheries are reef fishes, Spanish mackerel, kingfish, mullet, sponges, turtles, spiny lobsters (*Panulirus argus*), and stone crabs (*Menippi mercenaria*). The catch of conchs, although small, is peculiar to the Atlantic coast of the United States, and while the hard clam, or quahaug (*Venus mercenaria mortoni*), does not occur at Key West, the clam industry of southwest Florida is of great importance. Each of these furnishes an individual fishery that will be described in the following pages.

SMALLER REEF FISHES.

The small fishes inhabiting the reefs among the Florida keys are caught at all seasons of the year. They comprise, for the most part, grunts, snappers, yellow-tail, porkfish, porgies, turbot, jacks, and small groupers.

The boats used in this fishery are from 20 to 40 feet in length, with cockpit aft, fish well in the center, and with space for sleeping quarters, if so utilized, forward below deck. Generally but one

person, or at the most two, constitutes the crew. Fishing is done entirely with hook and line. The general equipment consists of numerous fish hooks and lines, a small minnow seine or cast net with which to secure fish bait, a pair of "grains" for spearing spiny lobsters also for bait, a small dip net for removing fish from the well when desired, a barrel of fresh water, a supply of food, an open-grate wood stove, some dry firewood, and the necessary bedding for accommodation over night.

Some of the fishermen return from the day's fishing by late afternoon, while others remain away for one or more days, fishing at more distant points where somewhat larger or perhaps more desirable fish may be found. The fishery is of local importance only, as these fish rarely are shipped from the city. Because of the regularity of the fishing throughout the year the value of the annual catch is quite large and assumes a prominent place among the other fishery resources of the region.

Practically all of these smaller fishes are kept alive until sold. Each boat, as already stated, is equipped with a fish well, where the fish are retained after they are removed from the hook. At the wharf the fisherman has one or more live cars in which the fish are placed in order to display them for sale, leaving the boat's well empty for the next fishing trip. A well-stocked live car is a pretty sight, as many of the reef fishes are beautifully colored.

A fishing boat without a well would be quite useless for reef fishing in this region, as the fish would spoil long before they could reach the market. Ice is used to preserve only those species that will not live in confinement, such as the mullet, kingfish, or Spanish mackerel. The fish well is carefully constructed of from 2 to 4 inch lumber, according to the size of the boat, and the seams are caulked with the same care that is given to the outer hull. At the base the four sides fit snugly with the contour of the boat and converge toward the top like a frustum of a pyramid, which the well diagrammatically resembles. The top of the well fits flush with the deck and is covered with a trapdoor, which is removed during actual fishing. The floor of the well, which is part of the hull, is pierced with numerous 1-inch holes to permit a constant interchange of water.

The necessary equipment for reef fishing is simple, the running expenses are small, the fishing grounds are near by, and the fish are readily caught and quickly sold. The fishery, however, does not appear to be overcrowded, for the markets are more liable to be without fish than to be overstocked.

LARGER REEF FISHES.

The larger reef fishes consist mostly of groupers, jewfish, hogfish, large porgies, and large snappers. They are taken throughout the year, although each at certain seasons furnishes better fishing than at other times. Larger boats are used, and fishing is carried on in deeper water than for the smaller reef fishes.

The few Key West boats that engage in this fishery range in length from 30 to 75 feet, or from the half-cabin dory type to the small schooner. Since hand lines only are used, the equipment is similar to that of the smaller boats. A crew of from two to five is

usually carried, and the boats remain away from several days to a week, or until the fish wells are sufficiently stocked to warrant a return to port. Cuban boats often fish near Key West, and sometimes they land at that city and dispose of their fish.

A portion of the catch is sold locally in Key West, but much the greater part is shipped to Cuba and to various cities in this country. The fish are brought in alive by the fishermen, but they are iced in the markets. Large boxes weighing about 200 pounds each, and holding 900 pounds of fish and 400 pounds of ice, are used in shipping fish to Cuba. The fish are transported to Cuba by large freight and passenger steamers that sail almost daily during the winter and several times a week during the summer. Each box is heavily constructed, and a number is painted on the side in large figures, so that a consignment can be checked and a record made of the empty boxes when returned. Shipments within the United States are made in barrels containing 200 pounds of fish and about 100 pounds of ice.

ANNOTATED LIST OF COMMERCIAL FOOD FISHES FOUND IN THE VICINITY OF KEY WEST.

In the following annotated list of fishes an attempt has been made to include every species found within the general vicinity of Key West that is locally considered a food fish. Some of the species mentioned are too scarce to be of much importance, while others are not regarded very favorably, but, nevertheless, these are included in order to make the list as complete as possible. Other species, such as sharks, rays, morays, and salt-water catfish, are taken but are excluded here because they are not locally regarded as food fish. All of the fishes listed are to be found within Monroe County, which includes the islands or keys from Key Largo south and a small area in the southwestern part of the Florida peninsula.

1. **Tarpon atlanticus** (Cuvier and Valenciennes). Tarpon; Silverfish.

The tarpon visits Key West during the winter months, but is not as common there as along the western coast of Florida. It is primarily a game fish and is rarely eaten. However, it is sometimes seen in the Key West markets, where it is sold in steaks at a low price. Because of its great game qualities the tarpon attracts many sportsmen to the State and is directly and indirectly a source of large annual revenue to the inhabitants. It is a very powerful fish and is caught only with hook and line, generally by trolling, using mullet for bait. It is most common in Florida and the West Indies. Maximum length about 8 feet; average, about 5 feet.

Range.—Isaacs Harbor and Harrigan Cove (Nova Scotia) to Brazil.

2. **Albula vulpes** (Linnæus). Ladyfish; Bonefish.

This fish is not rare among the Florida Keys and is sometimes found in the markets. However, it is not highly regarded as a food fish, and its commercial value is negligible. Maximum weight, about 5 pounds; average, 1½ pounds.

Range.—Tropical seas. Generally common on our coasts north to San Diego (Calif.) and Florida. Stragglers have been recorded as far north as Woods Hole, Mass.

3. **Tylosurus marinus** (Walbaum). Houndfish; Garfish; Needlefish.

The houndfish is common about Key West and other Florida keys. It is not highly regarded as a food fish and therefore is but rarely eaten. Usually only large examples, about 3 feet in length, are to be found in the markets. Several smaller species (*T. notatus* and *T. timucu*) are common, but never appear in the markets. *T. raphidoma* and *T. acus*, each attaining a length of 4 feet or more, are sometimes utilized for food. Although unimportant in the markets, all these species are good food fishes. On a dark and quiet night when rowing or poling a small boat these fish are commonly struck while swimming at the surface. On such occasions they rather startle one with their vigorous splashes over the surface gradually dying out in the distance, like stones skittered over a pond. Houndfish are taken in seines and with hook and line, but they take only a moving bait.

Range.—*T. marinus* is found from Casco Bay (Me.) to Texas, and is generally common from Chesapeake Bay southward. The other species mentioned are common from the Florida keys to Brazil, sometimes straying to North Carolina and northward. *T. acus* is recorded from as far north as Nantucket, Mass.

4. **Mugil curema** Cuvier and Valenciennes. White mullet; Silver mullet.

The silver mullet is abundant about Key West and all the other Florida keys, where the annual catch is nearly as great as that of the striped mullet (*M. cephalus*). It is taken with gill nets in brackish or salt water throughout the year. It prefers protected regions in bays, rivers, and about islands, and generally travels in schools over shallow bottoms, stirring up the mud in a search for food. Sometimes schools of a few hundred or a thousand fish simultaneously leave the water with a single jump, falling back with a resounding splash. Most of the spawning is believed to occur during May and June along the Florida keys, but no gravid fish have been observed. The silver mullet is a food fish of some importance in Key West, where it is sold either salted or fresh. Maximum size, about 14 inches; average, about 10½ inches.

Range.—Cape Cod to Brazil; Lower California to Chile.

5. **Mugil cephalus** Linnæus. Mullet; Jumping mullet; Striped mullet.

The striped mullet is fairly common among the Florida keys, but is not taken in large quantities in the immediate vicinity of Key West. The bulk of the catch is taken with gill nets. The striped mullet is an excellent food fish, and commercially it is the most valuable fish caught within the State of Florida. The mullet fishery is described elsewhere in this paper. Maximum size, 10 pounds; average size among Florida keys, 1½ pounds.

Range.—Widely distributed. Coasts of southern Europe and northern Africa; Atlantic coast of America from Casco Bay (Me.) to Brazil, and in the Pacific from Monterey to Chile. Abundant from Virginia to Texas.

6. **Sphyræna barracuda** (Walbaum). Barracuda; Picuda.

The barracuda is rather common among the Florida keys, where it is taken throughout the year, generally by trolling. It is a game fish of some merit and is much sought after by sportsmen. It is a large voracious fish, attacking prey larger than itself, and is much feared by bathers. At Key West it is a food fish of some importance, although its flesh is considered inferior. It is not sold in large quantities, but as many as 2 dozen may be seen in the market on certain days during the winter. Maximum size, about 8 feet; average, about 4 feet.

Range.—Cape Cod to Bahia, Brazil; Bermuda; Gulf of Mexico, north to Pensacola. Generally common in the West Indies and among the Florida keys; not common north of Florida.

7. **Upeneus maculatus** (Bloch). Red goatfish.

The goatfish is comparatively rare along the Florida keys, but is occasionally seen among the smaller fishes brought in by the hand-

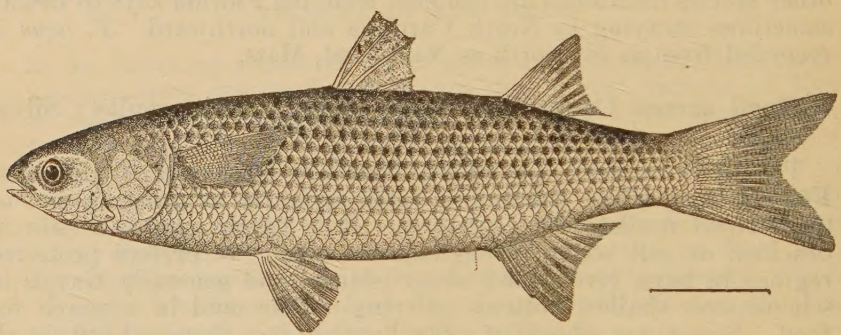

FIG. 2.—Striped mullet (*Mugil cephalus*).

line fishermen. In Porto Rico it is a food fish of considerable importance. Maximum size, about 12 inches; average, about 9 inches.

Range.—North Carolina to the West Indies; Bermuda, Cuba, Porto Rico, and Martinique. Rare north of Key West.

8. **Sarda sarda** (Bloch). Bonito.

The bonito is taken as a straggler along with the Spanish mackerel. It is a pelagic species inhabiting the Atlantic Ocean and is found both in Europe and in this country. It is a food fish of some importance, although inferior to the mackerel. The annual catch along the Florida keys is negligible. The maximum weight is about 15 pounds; average, 3 pounds.

Range.—Atlantic Ocean. Found along the European coast and on the North American coast from Casco Bay (Me.) to Florida, or perhaps farther south; not definitely recorded from Central or South America.

9. **Scomberomorus maculatus** (Mitchell). Spanish mackerel.

The Spanish mackerel is now the most valuable food fish taken in the immediate vicinity of Key West. However, it is only during recent years that large numbers have been caught in southern Flor-

ida. It is taken from November to April in this locality and is caught with gill nets, purse seines, and hook and line. It is one of the choicest food fishes taken on the Atlantic coast. A description of the fishery is included elsewhere in this paper. Maximum size, 25 pounds, which, however, is very exceptional, as individuals weighing 10 pounds are rare; average size of Key West fish, 2 pounds.

Range.—Monhegan (Me.) to Brazil. Not common north of Maryland. Small quantities taken in lower Chesapeake Bay from June until October; rather common off the North Carolina coast from May until October; most abundant in southern Florida. Distributed throughout the Gulf of Mexico, where its movements are irregular. Recorded from Jamaica, Porto Rico, and Panama. In Cuba it is rare. Found also on the Pacific coast from California southward.

10. **Scomberomorus regalis** (Bloch). Kingfish; Cero; Spotted cero; Sierra; Pintado.

The sierra, or kingfish, is a food fish of considerable importance among the Florida keys, but is somewhat less common than *S. cavalla*, with which it is closely associated. It is caught exclusively by trolling from motor or sail boats. The fishing season for this species extends from November to March. The kingfish fishery is described elsewhere in this paper. Maximum weight, about 35 pounds; average, about 5 pounds.

Range.—Monomoy (Mass.) to Brazil. Uncommon north of Florida; known from Cuba, Jamaica, Martinique, and Porto Rico.

11. **Scomberomorus cavalla** (Cuvier). Kingfish; Cero; Cavalla; Sierra.

This species is taken during the same season and under the same conditions as is the sierra (*S. regalis*), but because of its larger size and somewhat greater abundance it is the more important of the two. Considerable confusion has arisen over the common names of these two species, and the terms used appear to be interchangeable. As a rule, however, in the Key West markets *S. regalis* is known as "kingfish" or "sierra," while *S. cavalla* is called "kingfish" or "cero." Maximum weight about 75 pounds, but examples over 50 pounds are comparatively rare. Notwithstanding the many large fish caught, the average weight is only about 7 pounds.

Range.—Cape Cod to Africa and Brazil. Not common north of North Carolina: found in open seas of tropical Atlantic.

12. **Seriola dumerili** (Risso). Amberfish; Amber jack.

The amber jack is caught about Key West by trolling and is taken incidentally only during the winter along with the kingfish. It is considered a fine game fish. Its occurrence is irregular, and it appears never to be taken in large numbers in this region. Several hundred were brought to the Key West market during one week in January, 1919, and 35 fish were seen during the last week of February of the same year. The fish taken near Key West generally weigh from 20 to 70 pounds. In the markets the fish are dressed and cut into steaks for the local trade. Maximum weight, about 100 pounds; average, about 35 pounds.

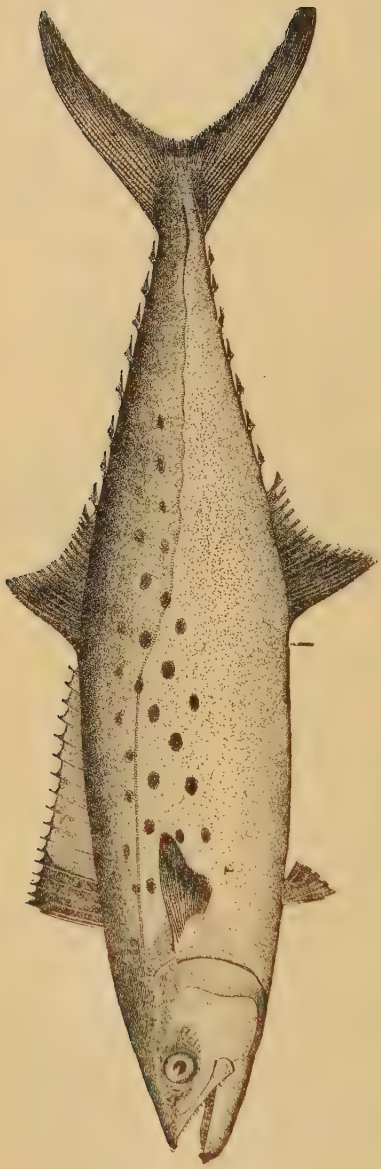

FIG. 3.—Spanish mackerel (*Scomberomorus maculatus*).

FIG. 4.—Kingfish, or sierra (*Scomberomorus regalis*).

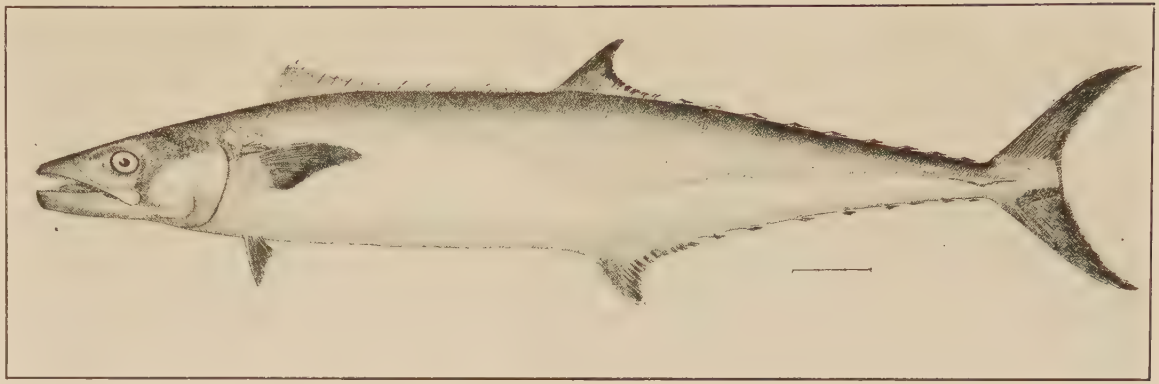

FIG. 5.—Kingfish, or cero (*Scomberomorus cavalla*).

With regard to this species the following is stated in "Fishes of Panama," by Meek and Hildebrand, now in press: "A study of material available in the National Museum indicates that this genus is in need of revision. We have included *Seriola lalandi* in our synonymy, believing it to be identical with the present species. There is a difference in the depth of body, but this appears to be only a variation among individuals. It also seems probable that the banded forms may yet prove to be the young of this species."

Range.—Cape Cod to Africa and Brazil. Not common north of North Carolina; found in open seas of tropical Atlantic.

13. **Decapterus punctatus** (Agassiz). Scad; Cigar-fish.

The scad is said to be rather common on the coasts of Florida, but its appearance in the Key West markets is only occasional. The annual catch does not exceed a few hundred pounds. The maximum size is not definitely known, but probably does not exceed 2 pounds, with an average of one-half pound.

Range.—Woods Hole (Mass.) to Brazil. Common in Bermuda and West Indies; small fish sometimes rather common about Woods Hole, Mass., and Long Island, N. Y.

14. **Selar crumenopthalmus** (Bloch). Big-eyed scad.

This fish is not common in the Key West markets. It is taken from time to time by the hook-and-line fishermen and is considered a fair food fish. Maximum weight, about 8 pounds; average, 1 pound.

Range.—Both coasts of tropical America and in tropical seas generally; on the Atlantic coast it is extremely rare north of southern Florida.

15. **Caranx bartholomæi** Cuvier and Valenciennes. Yellow jack.

This species is less abundant than the several other species of "jacks" commonly seen in the fish markets at Key West. It is common in the West Indies. The maximum weight is not definitely known, but it probably does not exceed 3 pounds; average, one-half pound.

Range.—Usual range Florida to West Indies and Panama. Known from Porto Rico, but not common there; common in Cuba; rare north of Florida, but sometimes straying to Woods Hole, Mass.

16. **Caranx hippos** (Linnæus). Jack; Runner; Crevalle.

This species is the most abundant of the various species of "jacks" or "runners" that are found about Key West. It is a good food fish and commands a ready sale in the markets. Fish weighing 5 or 6 pounds are not rare. It is taken by bottom fishing or by trolling and is worthy of mention as a game fish. It is found throughout the year, but is most common during the winter. Its maximum weight is 20 pounds, but it seldom weighs more than 10 pounds, and its average is 1 pound.

Range.—Both coasts of tropical America, north to Lynn, Mass., and Lower California; East Indies.

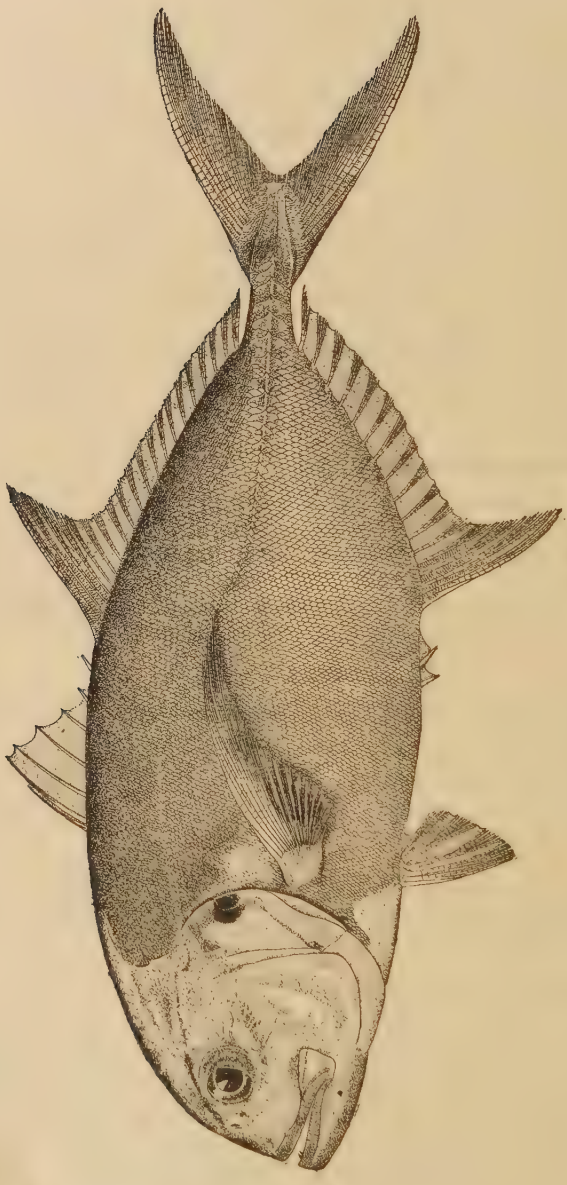

FIG. 6.—Jack (*Caranx hippos*).

17. **Caranx crysos** (Mitchill). Hard-tail; Jurel; Runner; Jack; Crevalle.

This species is taken throughout the year about Key West under the same conditions as is *C. hippos*. It is a food fish of importance locally but is smaller in size than *C. hippos*. Large numbers of half-pound fish are commonly found in the live cars about the fish wharves. Maximum weight, about 3 pounds; average, one-half pound.

Range.—Ipswitch Bay (Mass.) to Brazil. Common south of Maryland, entering lower Chesapeake Bay, where it rarely takes the hook but is rather common in pound-net catches.

18. **Caranx latus** Agassiz. Horse-eye jack; Jurel; Runner.

This species is less common about Key West than *C. hippos* or *C. crysos*. It is taken in small numbers by trolling, and sometimes a small school is captured in a Spanish-mackerel net. As a food fish it is not as highly regarded as the other species of Caranx. The maximum size is not known, but the average is not over one-half pound at Key West.

Range.—Virginia to Brazil.

19. **Vomer setipinnis** (Mitchill). Moonfish.

This little fish is caught very infrequently and only during the winter. It is taken on the bottom with hook and line and is esteemed as a food fish. The maximum weight is about 1 pound, and the average is one-third of a pound.

Range.—Halifax (Nova Scotia) to Uruguay; not common north of Virginia. The young are common in lower Chesapeake Bay during the summer and fall.

20. **Selene vomer** (Linnæus). Moonfish; Lookdown.

This species is often confused with *Vomer setipinnis* but may be distinguished from the latter at a glance by the prolongation of the first rays of the dorsal and anal fins. Around Key West it is somewhat more plentiful than Vomer. It is taken chiefly in the winter and is highly esteemed as a food fish. The annual catch is very small. Maximum weight, about 2 pounds; average, one-half pound.

Range.—Casco Bay (Me.) to Uruguay; not common north of Chesapeake Bay.

21. **Trachinotus glaucus** (Bloch). Gaff-topsail pompano.

This species is seldom taken at Key West and is confused by fishermen with other species of pompano. It may be identified by the long anterior rays of the soft dorsal and anal and by the presence of four black vertical bars on the back and sides. It is utilized for food, but the annual catch is negligible. Maximum weight, about 2 pounds; average, one-half pound.

Range.—Virginia to Panama; generally common along east coast of Florida and in Porto Rico.

22. **Trachinotus falcatus** (Linnæus). Round pompano.

This species, like *T. glaucus*, is seldom seen in the Key West markets. The few fish caught are called "pompano" and are utilized for food. Maximum weight about 3 pounds; average, one-half pound.

Range.—Woods Hole (Mass.) to Brazil. Adults not common north of Florida; young, 1 to 2 inches long, taken in southern Massachusetts and lower Chesapeake Bay, whence they are transported by the Gulf Stream. Rather common in Bermuda.

23. **Trachinotus goodei** Jordan and Evermann. Great pompano; Permit.

The great pompano is taken with hook and line near Key West during the winter. The annual catch, however, is small. It is a fair food fish, but inferior to the common pompano (*T. carolinus*). Maximum weight, about 40 pounds; average, 8 pounds.

Range.—Usual range North Carolina to West Indies; rare north of Florida. The young (about 3 inches long) have been recorded from Woods Hole, Mass.

24. **Trachinotus carolinus** (Linnæus). Common pompano.

This species is the most valuable of the pompanos and is considered one of the choicest of all salt-water fishes. About Key West it is taken in small numbers during the winter, but the annual catch is small. It is more common along both coasts of Florida, preferring sandy bottom, where it feeds near shore on small mollusks and crustaceans. At Key West it is taken with hook and line and, incidentally, in mullet seines. It always commands a high price and is esteemed for its rich flavor in all parts of its range. Maximum weight, 8 pounds; average, 1½ pounds.

Range.—Woods Hole, Mass., along the South Atlantic coast and Gulf of Mexico to Brazil. Not common north of Chesapeake Bay, in the West Indies, or Brazil.

25. **Pomatomus saltatrix** (Linnæus). Bluefish.

The bluefish is taken along the Florida keys only during the winter—generally between December 15 and February 15. A few are caught by trolling, but the greater part of the catch is taken along with the Spanish mackerel in gill nets or purse seines. During the past 10 years the annual catch has been from 10,000 to 15,000 pounds. The entire catch is shipped to New York, where it commands a high price, for fresh bluefish are scarce in northern markets during the winter. The bluefish is one of the best American food fishes. Its maximum weight is given as 27 pounds, but examples weighing more than 12 pounds are uncommon. The usual weight of the Key West fish is between 2 and 4 pounds, while 6 pounds is about the maximum.

Range.—Wide distribution; Atlantic and Indian Oceans; occasionally enters the Mediterranean Sea; Malay Archipelago; Australia; Cape of Good Hope; Natal; Madagascar. Not recorded from the Atlantic coast of Europe or from Bermuda. On our coast it has been recorded as far north as Mount Desert, Me.

26. **Rachycentron canadus** (Linnæus). Sergeant fish; Crab-eater; Black bonito.

This species is rarely caught along the Florida keys. It is a good food fish and has some commercial importance in the West Indies and along our Middle and South Atlantic States. It is taken with hook and line on rocky bottom, generally in 40 to 80 feet of water. In Chesapeake Bay, where it is called "black bonito," it is caught in small numbers from May until October, but it is most abundant during June. The largest fish recorded weighed 84 pounds and was taken in Chesapeake Bay during June, 1921. The average weight is about 10 pounds.

Range.—New Jersey to Brazil; East Indies.

27. **Centropomus undecimalis** (Bloch). Snook; Rabalo; Sergeant fish.

The snook is rarely taken in the immediate vicinity of Key West, but is common on the southwest coast of Florida, where it is one of the principal game fish taken during the winter. There it is taken by trolling, close to shore, from a rowboat that is operated as noislessly as possible. At Fort Meyers and Marco large snook are fre-

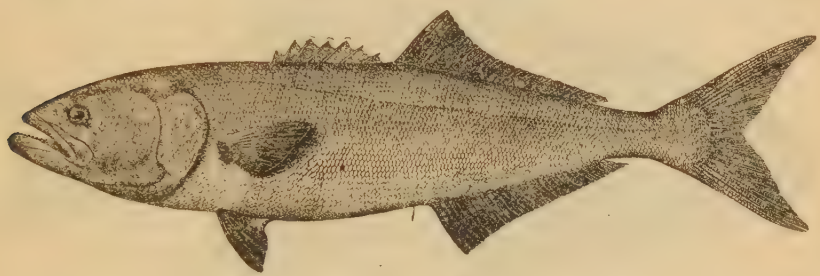

FIG. 7.—Bluefish (*Pomatomus saltatrix*).

quently seen swimming within a few feet of the shore. It ascends streams but does not stray far from brackish water. The snook is rather uncommon among the Florida keys and is too scarce in the Key West markets to be of local commercial importance. It is considered a fair food fish. The maximum weight is about 30 pounds, while the average is about 3 pounds.

Range.—Atlantic coast of tropical America. Recorded from Florida; Porto Rico; Cuba; Haiti; Jamaica; Martinique; Barbados; Vera Cruz, Mexico; Belize, British Honduras; Toro Point, Colon, Mindi, New Gatun, and Porto Bello, Panama; British Guiana; French Guiana; and Bahia, Sao Mathews, and Rio Janeiro, Brazil. (Meek and Hildebrand.)

28. **Epinephelus adscensionis** (Osbeck). Rock hind; Cabra mora.

This beautiful species is less common than most of the other groupers found about Key West. Its habitat is restricted to rocky bottoms in rather deep water, and it is seldom caught on shallow reefs along with grunts and snappers. Generally not more than half a dozen are to be seen on any one day at the fish markets, but when a deep-water fisherman comes to port this fish is usually well repre-

sented in his catch. In Key West it is esteemed as a food fish. Maximum weight, about 15 pounds; average, 2 pounds.

Range.—Usual range southern Florida to Brazil. Known from Ascension and St. Helena Islands and Cape of Good Hope; rare north of Miami. The young are reported from Katama Bay, Mass.

29. **Epinephelus striatus** (Bloch). Nassau grouper; Cherna criolla.

This grouper is one of the large and important food fishes of Key West. It is caught on the bottom with hook and line and is taken throughout the year. Market fish are seldom found in water less than 30 feet in depth. Very small examples of about 1 pound are seldom seen, and most of the market fish range from 3 to 35 pounds. Large fish will live for some time in the live cars attached to the wharves. The Nassau grouper closely resembles the red grouper (*E. morio*), but it is easily separated from the latter by the presence of a persistent black spot between the dorsal and upper part of the tail fin. Maximum weight, about 50 pounds; average, 5 pounds.

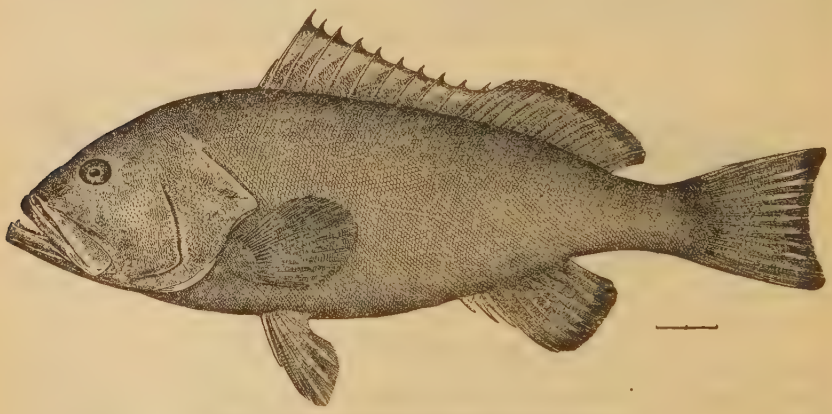

FIG. 8.—Red grouper (*Epinephelus morio*).

Range.—North Carolina to Brazil; rare north of the Florida keys; common in Porto Rico and Bermuda.

30. **Epinephelus guttatus** (Linnæus). Red hind.

This is one of the most strikingly colored of the groupers, the body being marked everywhere with vivid scarlet spots. It is fairly common among the Florida keys and is a valuable market species, although much less so than the red grouper. It is caught with hook and line at moderate depths. Maximum weight, about 5 pounds; average, 2 pounds.

Range.—South Carolina, Florida, Bermuda, throughout the West Indies to Brazil.

31. **Epinephelus morio** (Cuvier and Valenciennes). Red grouper.

The red grouper is the most abundant and best known of the Key West groupers. It is most common during the winter, but is taken throughout the year on rocky, coral, and grassy bottoms. This fish is widely distributed over the fishing grounds and may be taken in

FIG. 6.—Nassau grouper (*Epinelphelus striatus*).

from 10 to 20 feet of water along with grunts, porgies, etc., or it may be caught on the deeper rocky reefs. The fish taken in shallow water usually are small, weighing from one-half to 2 pounds, while those from deeper water generally range from 2 to 15 pounds. Fish weighing more than 20 pounds are not common. The red grouper bears transportation well and is shipped north and to Cuba. It will live for long periods in live cars and fish wells and is one of the favorite food fishes of Key West. Maximum weight, 40 pounds; average, 5 pounds.

Range.—Massachusetts to Brazil; common in the Gulf of Mexico and at Bermuda; uncommon north of Florida, and found only as a rare straggler north of North Carolina.

32. **Epinephelus nigritus** (Holbrook). Black jewfish.

This large grouper is reported as fairly common off the coast of Florida, but it is rarely seen in the Key West markets. Maximum weight, 500 pounds.

Range.—South Carolina to Brazil; Mediterranean Sea.

FIG. 10.—Spotted jewfish (*Promicrops itaiara*).

33. **Promicrops itaiara** (Lichtenstein). Jewfish; Spotted jewfish.

The spotted jewfish is the largest food fish caught in the vicinity of Key West and is one of the largest of all fishes. This fish is not plentiful in the Key West region in point of numbers, but because of the large size attained the comparatively few fish taken are of some commercial importance. During the greater part of the years 1918 and 1919 from two to six jewfish were brought to the Key West market each week. Spawning occurs during July and August, when the fish become gregarious and are caught in greatest numbers. During six weeks of July and August, 1918, there were brought to market 74 jewfish, ranging in weight from 35 to 350 pounds, with a mean average of 125 pounds. Nearly all of these were taken off Knights Key, about 40 miles above Key West.

The jewfish is caught with hook and line on very strong tackle. Regardless of its large size, it is placed in the well of the boat after capture and is brought to market alive. At the market the fish are transferred to commodious live cars, and as an extra precaution to preclude their escape, a large hook is placed in the mouth of each

big fish and each is securely hitched to a pile by means of a strong line. The fish are removed from the live cars as wanted. When the fish are dressed, the scales are shaved off with a sharp knife, and the flesh is cut into steaks and strips. The flesh sells for about 20 cents a pound and always finds a ready sale, the entire catch being consumed locally.

The jewfish prefers moderately deep water with rocky or coral bottom. Small individuals weighing from 1 to 10 pounds, however, are frequently taken in shallow water close to shore. The species is particularly common on the southwest coast of Florida. The largest fish of which there is a reliable record weighed, according to a measurement formula, 693 pounds. This fish was caught with shark tackle on January 23, 1923, about 35 miles south of Miami, and it was 8 feet long and 6 feet 4 inches in girth.

Range.—Both coasts of tropical America, north to Florida and the Gulf of California.

34. **Mycteroperca venenosa** (Linnæus). Yellow-finned grouper; Yellow grouper.

This grouper is uncommon about Key West and is seen only occasionally in the fish markets, but it is somewhat more plentiful in the Habana markets. Maximum weight, 20 pounds; average, 5 pounds.

Range.—North Carolina to the Bahamas; southern Florida, Bermuda, and the West Indies; rare north of Miami.

35. **Mycteroperca bonaci** (Poey). Black grouper.

The black grouper is rather common about the Florida keys and Key West. It is not taken in large numbers, but its great size makes it one of the most important market fishes. It is generally caught in water more than 25 feet in depth, but small fish are occasionally taken in shallow water near shore. This grouper is taken throughout the year, but it is most common during February, March, and April. The usual market fish weigh from 5 to 50 pounds; fish weighing more than 50 pounds are uncommon though not rare. Large or small fish can be kept in live cars for long periods. Maximum weight, about 100 pounds; average, 10 pounds.

Range.—Usual range Florida to Brazil. The young have been carried by the Gulf Stream as far north as Woods Hole, Mass.

36. **Mycteroperca microlepis** (Goode and Bean). Gag.

This species is rather common about Key West and may be caught there throughout the year. It is generally taken on the shallow reefs in 10 to 25 feet of water and on rocky, coral, or grassy bottoms. When hooked, it puts up a somewhat better fight than do most of the other groupers. It is a good food fish. Maximum weight, 20 pounds; average, 1½ pounds. Fish weighing more than 10 pounds are rare, and the weight of the market fish usually ranges from one-half to 3 pounds.

Range.—Beaufort (N. C.) to Florida; on the Gulf coast to Pensacola.

37. **Mycteroperca falcata phenax** Jordan and Swain. Scamp.

This species is rather common about the Florida keys, although much less so than the red grouper. It is caught with hook and line and is present in the markets throughout most of the year. Another species (*M. falcata*) closely resembling this one is common in the Habana markets. As a food fish it is well regarded and ranks higher than many of the other groupers. Maximum weight, 10 pounds; average, 2 pounds.

Range.—Southern Florida.

38. **Lobotes surinamensis** (Bloch). Triple-tail.

This fish is rare at Key West but occasionally is seen in the markets. A 20-pound individual was observed in the market during January, 1919, and was considered an oddity by the fishermen, who had no name for it. The triple-tail is considered a good food fish, but it is not common anywhere. A specimen 6 inches long was caught near the Bureau of Fisheries' biological station at Key West. Maximum weight, about 35 pounds; average, 8 pounds.

Range.—Massachusetts south to Uruguay; taken sparingly in lower Chesapeake Bay pound nets, where it is called "strawberry bass."

39. **Lutianus griseus** (Linnæus). Gray snapper; Mangrove snapper.

The gray snapper is the most abundant species of snapper found at Key West. The fish always travel in schools, generally containing from a few hundred to a thousand fish of various sizes, and prefer the sloping ledges of reefs and channel ways. If not alarmed, they will hover in one place for hours and afford a beautiful sight in the clear water. Under certain conditions it is extremely difficult to catch adult gray snappers with hook and line, but fish of less than 6 inches are less wary and can be taken without difficulty. Many attempts to catch one were made by the writer, with various lures. Pieces of bait thrown into the water were readily taken by the larger fish, but as soon as fishing tackle was introduced the fish looked askance at the bait and kept their distance. A tiny hook and black sewing thread were tried without much success. The best snapper fishing was found to occur when the weather was cloudy and the water not very clear.

This snapper has the peculiar habit of lying in a few inches of water among the roots of the mangroves, especially where the tide flows swiftly between small islands, hence the name "mangrove snapper." The writer has found five or six fish within half an hour under such conditions.

The gray snapper is an abundant species but because of its wariness is not caught in large quantities by the fishermen. Enough are caught, however, to make it an important market species. It is a good food fish and is taken throughout the year. It is caught along the west coast of Florida as far north as Bay County and is especially common on the southwest coast. It is also found along the east coast of Florida and as far north as Woods Hole, Mass. It is rare above North Carolina, however. Market fish usually range in weight from one-half to 5 pounds. Large fish weighing fully 10

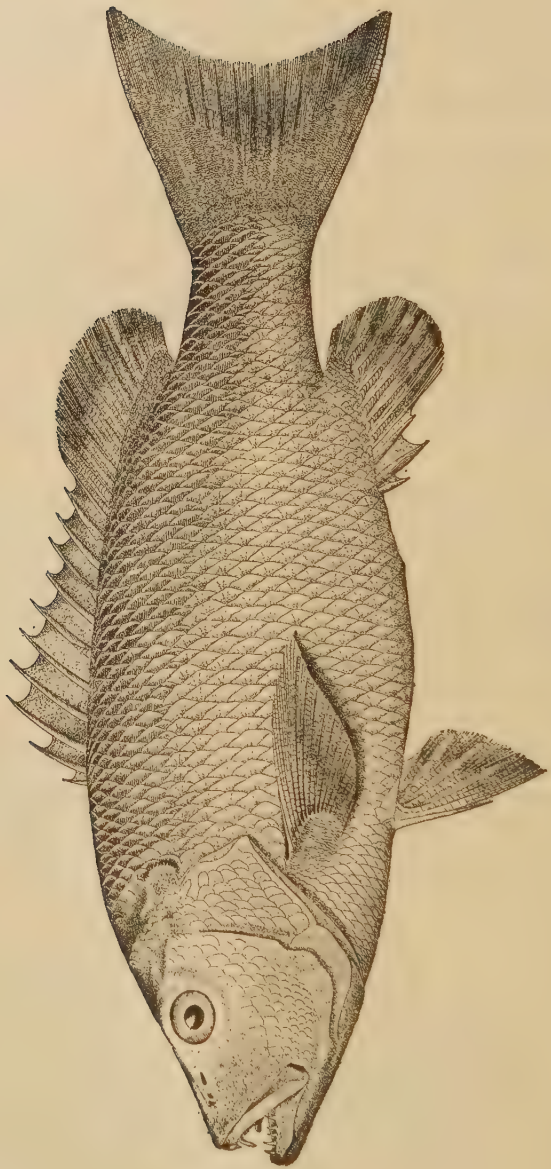

FIG. 11.—Gray snapper (*Lutianus griseus*).

pounds are often seen in the water, but fish of this size are seldom caught. The maximum weight is said to be 18 pounds.

Range.—Usual range both coasts of Florida to the West Indies. The young, a few inches long, have been recorded from North Carolina, lower Chesapeake Bay, New Jersey, Rhode Island, and Woods Hole, Mass.; common in Bermuda.

40. **Lutianus jocu** (Bloch and Schneider). Dog snapper.

This snapper is not common about the Florida keys. It is caught chiefly in the fall and winter, and only an occasional fish is seen throughout the summer. It is taken with hook and line along with other snappers and grunts and is a good food fish. Maximum weight, 20 pounds; average, 2 pounds.

Range.—Usual range Miami to Bahia, Brazil. The young have been taken at Woods Hole, Mass.

41. **Lutianus apodus** (Walbaum). Schoolmaster.

This species is rather common in the vicinity of Key West, but its commercial value is relatively small. The young are abundant about the shores of Key West and all the Florida keys. Small fish are sometimes found lying motionless at the base of rocks close to shore. Fish of about one-third to one-half pound are taken on the shallow reefs along with grunts, porgies, etc. Larger fish, weighing 2 to 6 pounds, are taken in small numbers in deeper water. Maximum weight, 8 pounds; average, three-fourths of a pound.

Range.—Usual range Florida to Bahia, Brazil; Bermuda. It occurs as a straggler north of Florida. The young have been taken at Beaufort, N. C., and Woods Hole, Mass.

42. **Lutianus aya** (Bloch). Red snapper.

The red snapper is one of the most abundant and valuable fish caught within the State of Florida, but near Key West it is comparatively scarce. At times a few are taken in deep channels near certain of the keys. Several million pounds are caught annually in the Gulf of Mexico, where the greater part of the catch is landed at Pensacola. It is caught with hand lines in 15 to 50 fathoms of water, and the bait used generally consists of pieces of meat or fish. The red snapper bears transportation well and is shipped to all the important fish markets of the north. It is considered a choice food fish. Maximum weight, 79 pounds; average, 6 pounds.

Range.—Woods Hole (Mass.) to Brazil; Bermuda; rare north of North Carolina; taken in commercial quantities off Cape Fear (N. C.), Georgia, eastern Florida, Gulf of Mexico, Porto Rico, and Central America.

43. **Lutianus analis** (Cuvier and Valenciennes). Muttonfish; Pargo.

The muttonfish is one of the most important species of snappers caught about Key West, ranking close to the yellowtail (*Ocyurus chrysurus*). It is found throughout the year but is scarcest during July and August, which is the spawning period and at which time it schools. The muttonfish is an excellent food fish and is always in demand. It takes the baited hook freely and is quite gamey. Near Key West it is taken on rocky or coral bottom in 3 to 9 fathoms

of water, but small fish of one-half to 2 pounds are sometimes taken on the shallow reefs, in 2 to 4 fathoms, along with grunts, porgies, etc. The average size of deep-water fish is about 3 pounds, but examples weighing 15 and 20 pounds are not rare. It is reported that a 25-pound fish was caught off the railroad pier at Key West by an angler using rod and reel. Maximum weight, 25 pounds; average, 3 pounds.

Range.—Usual range both coasts of Florida to Brazil. The young have been recorded from Beaufort, N. C., and Woods Hole, Mass.

44. **Lutianus synagris** (Linnæus). Lane snapper; Red-tailed snapper.

The lane snapper is a beautiful and abundant fish about Key West. It is usually caught on rocky, coral, or grassy bottoms in water ranging in depth from 2 to 6 fathoms. It is found in company with various species of grunts, porgies, snappers, and groupers. Although the average size is only about one-half pound, it is rather gamey when hooked. It is caught in greatest numbers during the winter and spring. Spawning is said to take place in October, at which time the fish gather in schools. Maximum weight, 4 pounds; average, one-half pound.

Range.—Pensacola and Indian River, Fla., southward to Brazil; known from the Bahamas, Cuba, Martinique, Jamaica, Santo Domingo, Porto Rico, and Panama.

45. **Ocyurus chrysurus** (Bloch). Yellowtail; Rabirubia.

The yellowtail is perhaps the most important of all the snappers found about Key West. It is one of the most esteemed of the local fishes and is abundant throughout the year excepting during the winter when the cold drives it away to deeper water. It may be caught at depths of 2 or more fathoms, and it is especially abundant on the rocky edges of the outer reefs near Key West. This fish is rather gamey and is caught with crawfish or sardine bait. Fish weighing 3 and 4 pounds are not uncommon; the maximum size is 6 pounds and the average 1 pound.

Range.—Usual range southern Florida to Brazil; known from Bermuda, Cuba, Martinique, St. Kitts, Jamaica, Porto Rico, and Brazil. The young are recorded from Katama Bay, Mass.

46. **Hæmulon album** Cuvier and Valenciennes. Margate fish; Margaret grunt.

This species is not as common about Key West as are several other grunts, but is one of the largest of the grunts and a good food fish. It is taken in rather deep water on rock or coral reefs. Spawning occurs during the early summer. Its food consists chiefly of crabs, crawfish, worms, etc. Maximum weight, 10 pounds; average, 2 pounds.

Range.—Southern Florida to Brazil; reported from Bermuda, the Bahamas, Habana, Jamaica, Porto Rico, and St. Thomas.

47. **Hæmulon macrostomum** Günther. Gray grunt; Striped grunt.

This grunt is common among the Florida Keys but because of its small size is considerably less important than various larger species. Young fish 4 to 6 inches long are sometimes abundant close to shore

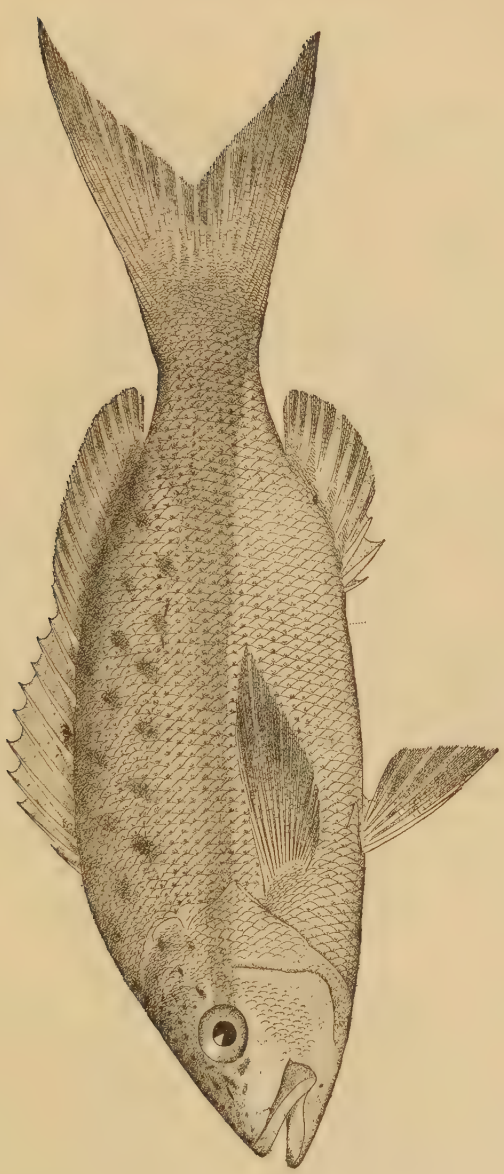

FIG. 12.—Yellow-tail (*Ocyurus chrysurus*).

in shallow water. Like all the grunts, it is caught with hook and line, and fish taken for market purposes are at least 7 inches long. Maximum weight, 1 pound; average, one-third pound.

Range.—Southern Florida to Panama; known from Bermuda, Jamaica, St. Thomas, Porto Rico, and Panama.

48. **Hæmulon parra** (Desmarest). Sailor's choice; Grunt; Ronco prieto.

This is a common species about Key West. It is generally found in schools close to shore in company with the gray snapper. Apparently but few are taken offshore as far as even 1 mile. Fish 5 and 6 inches in length are very abundant and readily take the baited hook but are too small to be of commercial importance. However, many are taken weighing from one-half pound to a pound, or more. Maximum weight, 2 pounds; average, one-half pound.

Range.—Southern Florida to Brazil; recorded from Cards Sound, Marco, Lemon Bay, Biscayne Bay, Tortugas, Habana, Jamaica, Porto Rico, Panama, and Brazil.

49. **Hæmulon sciurus** (Shaw). Yellow grunt; Boar grunt; Ronco amarillo.

This species is perhaps the most beautiful of all the grunts and is marked by numerous longitudinal yellow stripes. It is very common about Key West, ranking next to *H. plumieri* in abundance. It is generally caught near the roots of mangrove trees in 6 to 15 feet of water, but some are taken farther offshore on hard bottom. The best bait is a long worm, which the fishermen get from the stem of a tall grass that grows on certain bars near shore. These "podworms" are certain to attract yellow grunts if there are any in the vicinity. If the most favorable places to fish are known, it is possible to catch 50 to 100 fish in a few hours. One fisherman reports that he has caught as many as 600 yellow grunts in a single day. The best fishing obtains during the summer. The yellow grunt is an important food fish in Key West. Maximum weight, about 1 pound; average, one-half pound.

Range.—Southern Florida to Brazil; recorded from Biscayne Bay, the Tortugas, Bermuda, Cuba, Jamaica, Panama, and Bahia.

50. **Hæmulon plumieri** (Lacépède). Common grunt; White grunt; Ronco.

This is by far the most abundant of all the grunts, and in point of numbers it is probably not exceeded by any other food fish in the vicinity of Key West. It is caught with hook and line baited with crawfish or "sardines" in 8 to 40 feet of water. It is found on bottoms of sand, marl, coral, or rock, which may be open or covered with vegetation. The best fishing, however, is found on rocky bottom. The common grunt is caught all the year round but is particularly abundant in the late summer and fall. After spawning (during August and September), the large schools break up and scatter but the fish are usually found in small schools on the bottom. Maximum weight, 3 pounds; average, one-third to one-half pound.

Range.—Cape Hatteras and Pensacola to Brazil; recorded from Panama.

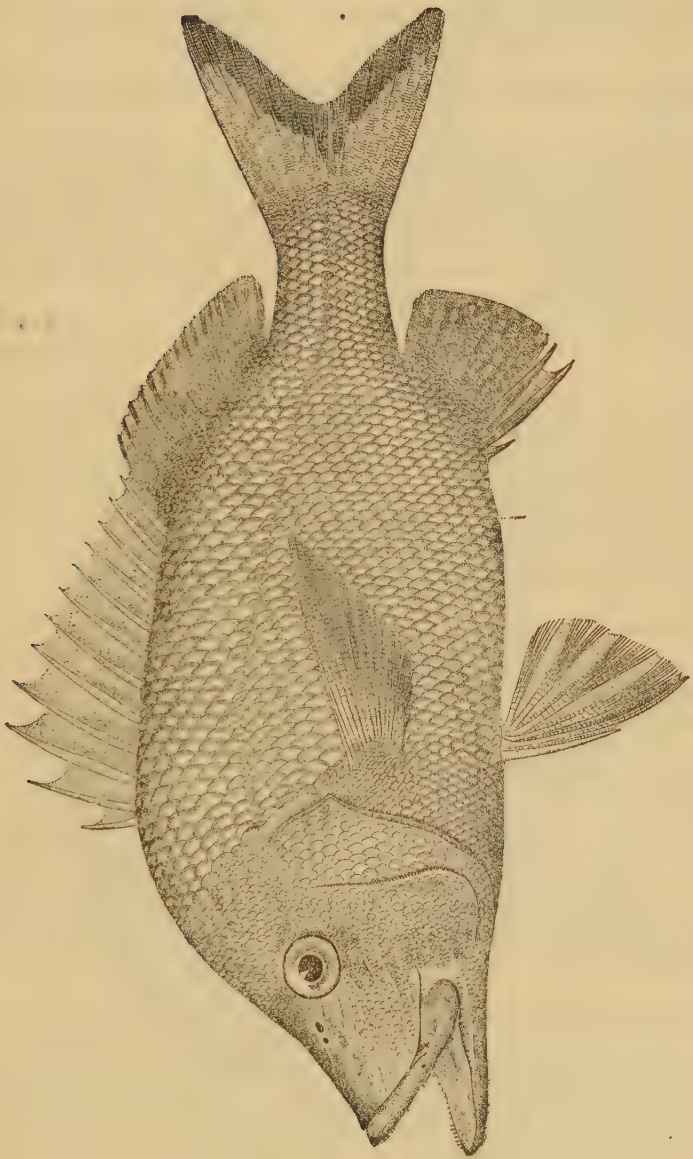

FIG. 13.—Common grunt (*Hæmulon plumieri*).

51. **Hæmulon flavolineatum** (Desmarest). French grunt; Ronco condenado.

This little grunt is not very common at Key West and is only occasionally seen in the fish wells. Maximum weight, 1 pound; average, one-third pound.

Range.—Bermuda, Florida Keys, Tortugas, south to Brazil; recorded from Panama.

52. **Bathystoma rimator** (Jordan and Swain). Tom-tate; Red-mouth grunt.

The young (4 to 6 inches long) are abundant about Key West, but fish of marketable size are uncommon and for this reason the annual catch is comparatively small. They are seen occasionally in the live cars and are sold along with other grunts and small snappers. Spawning takes place in May and June. Maximum weight, about 1 pound; average, one-third pound.

Range.—Cape Hatteras and Pensacola, southward through the West Indies to Trinidad; recorded from Panama and Bermuda.

53. **Anisotremus surinamensis** (Bloch). Black margate-fish.

This is a comparatively rare species about the Florida keys and is seen only occasionally in the live cars about the wharves. Probably not more than 1,000 pounds are brought to Key West annually. Maximum weight, about 20 pounds; average, 2 pounds.

Range.—Florida and Mobile to Brazil; known from Surinam, Martinique, Porto Rico, Jamaica, Cuba, and Panama.

54. **Anisotremus virginicus** (Linnæus). Porkfish.

This brightly marked species is common about Key West and is one of the important small food fishes. From June to August, when it schools to spawn, it is found about the shoals but soon retires to deep water. About a month after the spawning season large numbers of young may be seen about the shoals. When fishing in comparatively deep water (30 to 40 feet), it is not unusual to catch fish of a pound or a little more in weight. However, fish of one-half a pound or less comprise the bulk of the annual catch. It is a good food fish. Maximum weight, 2 pounds; average, one-third pound.

Range.—Florida to Brazil; known from Biscayne Bay, Santo Domingo, Jamaica, Porto Rico, Martinique, Panama, and St. Catherines Island, Brazil.

55. **Orthopristes chrysopterus** (Linnæus). Pigfish; Hogfish.

This species is fairly common about Key West and is taken with hook and line on shallow reefs along with other grunts and snappers. It is an important species in lower Chesapeake Bay and along the South Atlantic coast, where it is considered an excellent food fish. Maximum weight, 2 pounds; average, one-half pound.

Range.—New Jersey to Mexico; recorded from Bermuda.

(NOTE.—The author is indebted to Dr. H. B. Bigelow for furnishing extensions to the northern range of certain species included in this list. These new ranges are included in "Fishes of the Gulf of Maine," by H. B. Bigelow and W. W. Welsh, now in press.)

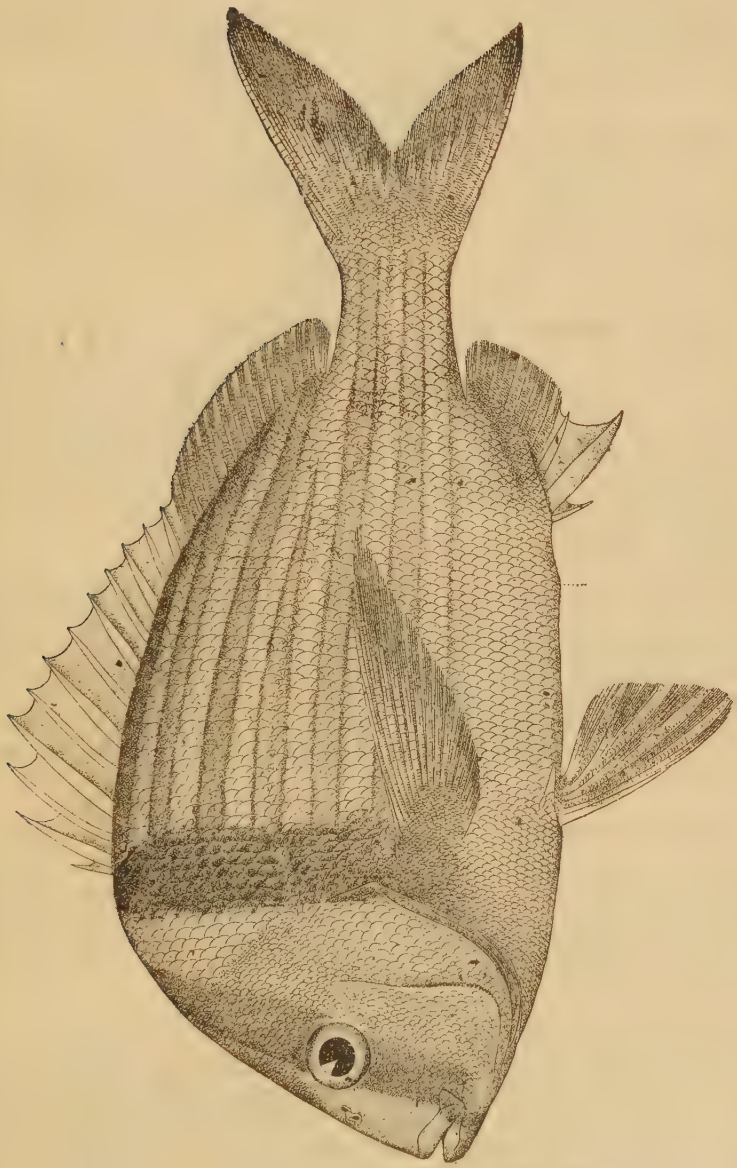

FIG. 14.—Porkfish (*Anisotremus virginicus*).

56. **Calamus calamus** (Cuvier and Valenciennes). Saucer-eyed porgy.

This is a common species about Key West and is found throughout the year, but it is most abundant during the winter. It is taken with hook and line on coral bottom in 12 to 40 feet of water. This and other species of porgies all are important food fishes in Key West. Maximum weight, 1¼ pounds; average, one-half pound.

Range.—Florida keys to Brazil; known from Bermuda, Martinique, Jamaica, Cuba, Porto Rico, and Panama.

57. **Calamus proridens** Jordan and Gilbert. Little-head porgy.

A common species in Key West and always present in the live cars. This and other species of porgies found here are sold together without respect to species. Maximum weight, 2 pounds; average, one-half pound.

Range.—Florida keys to West Indies.

58. **Calamus bajonado** (Bloch and Schneider). Jolt-head porgy; Bajonado.

This is the largest of the porgies and because of its size is the most important member of the group found at Key West. It is found on rocky, coral, and grassy bottoms at a depth of 15 to 40 feet or more. Spawning takes place during July and August. Fishermen catch it with hook and line all the year round. Maximum weight, 10 pounds; average, 2 pounds.

Range.—Southern Florida to West Indies.

59. **Calamus penna** (Cuvier and Valenciennes). Sheepshead porgy.

The sheepshead porgy is a common species and is most abundant in the winter. It frequents shallow water near the keys. Maximum weight, 4 pounds; average, 1 pound.

Range.—Southern Florida to Brazil; known from Charlotte Harbor, St. Thomas, Habana, Panama, Camamu, Rio de Janeiro, and Rio Grande do Sul.

60. **Calamus arctifrons** Goode and Bean. Grass porgy.

This is an abundant species locally, especially in shallow water and on grassy bottom. It is found in company with other species of porgies. Maximum weight, 2 pounds; average, one-half pound.

Range.—Pensacola and Biscayne Bay south to Key West and Porto Rico; not common in the West Indies.

61. **Lagodon rhomboides** (Linnæus). Pinfish; Sailor's choice; Bream.

This little fish is abundant about the shores and wharves of Key West and is one of the most common species taken with hook and line in the vicinity of the Bureau of Fisheries biological station. It is a ready biter and will take a hook baited with fish, spiny lobster, hermit crab, and many other kinds of bait. It is seldom caught out on the reefs away from shore. It is a good pan fish, but because of its small size its commercial value in Key West is slight. A fish

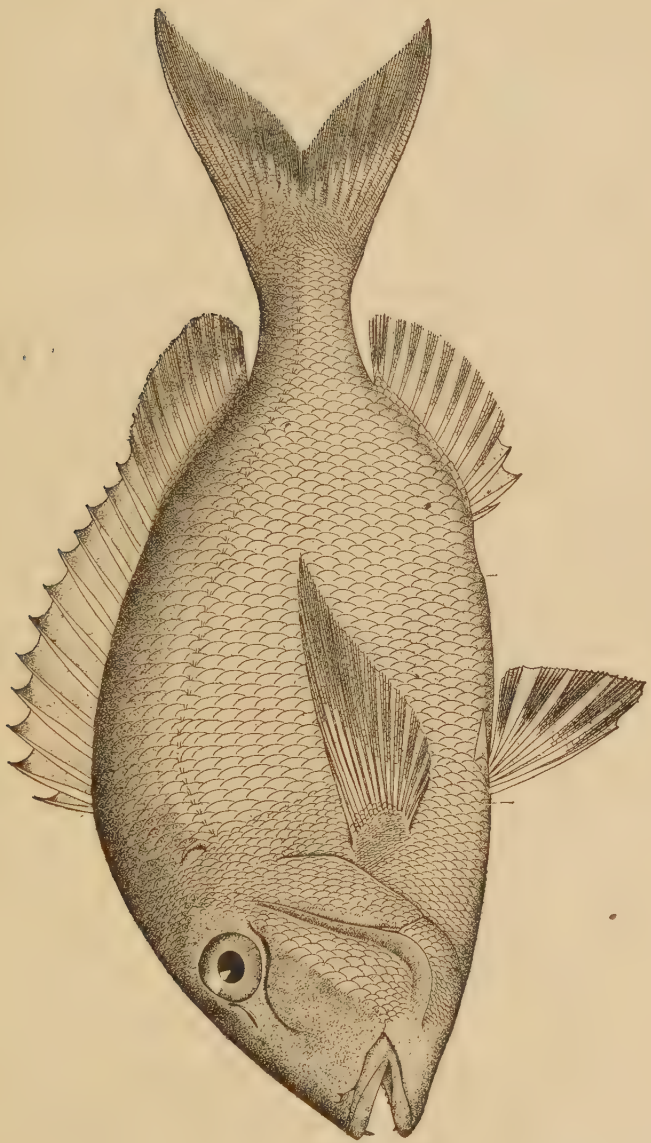

FIG. 15.—Jolt-head porgy (*Calamus bajonado*).

13 inches long, taken by the writer, is the largest recorded. Its average size is 6 inches.

Range.—Cape Cod to Texas; Bermuda and Cuba; common in lower Chesapeake Bay and abundant off the Carolina coast.

62. **Archosargus unimaculatus** (Bloch). Brim; Bream; Salema.

This species is not common about Key West, although a few are seen from time to time in the live cars at the wharves. It is a good food fish, but because of the small catch its commercial value is very limited. In Porto Rico it is an abundant and important food fish. Maximum weight, about 2 pounds; average, one-half pound.

Range.—Charleston to Rio de Janeiro, Brazil; rare north of Florida Keys; reported from Charleston, Cuba, Jamaica, Porto Rico, Panama, and Brazil.

63. **Archosargus probatocephalus** (Walbaum). Sheepshead.

The sheepshead is not common in the immediate vicinity of Key West, where the annual catch is only a few hundred pounds, but it is one of Florida's most important food fishes and is caught in large numbers on both coasts. However, it is most abundant off the southwest coast along the shores of Lee, De Soto, and Manatee Counties. At Marco the writer caught many sheepshead while fishing directly from the shore. It is found chiefly about wharves, wrecks, and mangrove roots. The greater part of its food consists of crabs and mollusks, which it can easily crunch with its strong teeth. Maximum weight 30 pounds, but individuals over 15 pounds are comparatively rare; average weight, 3 pounds.

Range.—Atlantic and Gulf coasts, from Cape Cod to Texas; formerly rather common, but now rare north of Cape Henry, Va. In Chesapeake Bay, where it was once common, it is now very scarce.

64. **Xystæma cinereum** (Walbaum). Broad shad; Majarra.

This small fish is taken in limited numbers about the Florida keys, where it is caught with hook and line in water 8 feet or more in depth. The annual catch is perhaps not over a few hundred pounds. It is an excellent food fish, and in Porto Rico it is an important market fish. Maximum weight, 2 pounds; average, one-half pound.

Range.—Both coasts of tropical America, north to Lower California, and southern Florida.

65. **Kyphosus sectatrix** (Linnæus). Rudder-fish; Bermuda chub.

This species is not commonly seen in the markets of Key West, and it is found only sparingly about the keys throughout the year. It is known for its peculiar habit of following vessels at sea, presumably for the waste food thrown overboard. It is said to be a worthy game fish. Maximum weight, 9 pounds; average, 2 pounds.

Range.—Cape Cod to Panama; not common on the Carolina coast, north of which it is a rare straggler; recorded from Bermuda and Porto Rico and said to occur in the Canary Islands and rarely in the Mediterranean.

66. **Cynoscion nebulosus** (Cuvier and Valenciennes). Spotted trout; Speckled trout; Spotted squeteague.

This important food fish is rarely, if ever, taken within the immediate vicinity of Key West. It is a valuable and abundant species on both coasts of Florida, however. Small numbers are taken among the Florida keys, near Cape Sable, while fishing for mullet, and it is seen in the Key West markets in company with this species. Various methods are used in catching the spotted squeteague. In lower Chesapeake Bay, where it is an important food fish, it is caught in pound nets, haul seines, and set seines; in southern Florida it is taken in mullet nets and with hook and line. Among the Ten Thousand Islands a fisherman was observed fishing from a flatboat with hook and line attached to a long bamboo pole. He drifted over grassy flats, repeatedly casting with mullet bait, and succeeded in catching many squeteagues. In St. Andrews Bay, Fla., the writer caught many "speckled trout" while trolling from a boat and using artificial lures. The largest fish recorded weighed 16½ pounds and was taken in the Neuse River, N. C. Two 16-pound fish were observed in Chesapeake Bay during 1922. The average weight is about 2 pounds.

Range.—New York to Texas; rare north of Chesapeake Bay.

67. **Sciænops ocellatus** (Linnæus). Redfish; Channel bass; Red drum.

This species, called "redfish" in the South, is not caught in the immediate vicinity of Key West, but it is occasionally taken among some of the Florida keys, and at times small numbers are seen in the local markets. On both coasts of Florida it is a food fish of considerable value. In traveling from one coast to the other it appears evident that the channel bass rounds Cape Sable and does not stray very far south among the keys. It is a good game fish, and large individuals are caught by surf-casters along the New Jersey coast and elsewhere. Maximum weight, 75 pounds; average, 2 to 35 pounds.

Range.—Massachusetts to Texas; not common north of Chesapeake Bay.

68. **Pagonias cromis** (Linnæus). Black drum.

The black drum is not caught in the immediate vicinity of Key West but, like the red drum, is occasionally taken among the keys. It is seldom seen in the local markets. As a food fish it is rather inferior, the flesh being coarse and stringy. Maximum weight, 146 pounds; average, about 25 pounds.

Range.—Massachusetts to Texas.

69. **Lachnolaimus maximus** (Walbaum). Hogfish; Capitan.

The hogfish is common about Key West and is caught the year round on rocky reefs in rather deep water. It is a fairly good food fish, though not choice, and is always present in the fish wells and live cars. When the fish is dressed, the scales are shaved off with a sharp knife in the same manner as with groupers and jewfish. Maximum weight, 20 pounds. Fish weighing 10 pounds or more are not

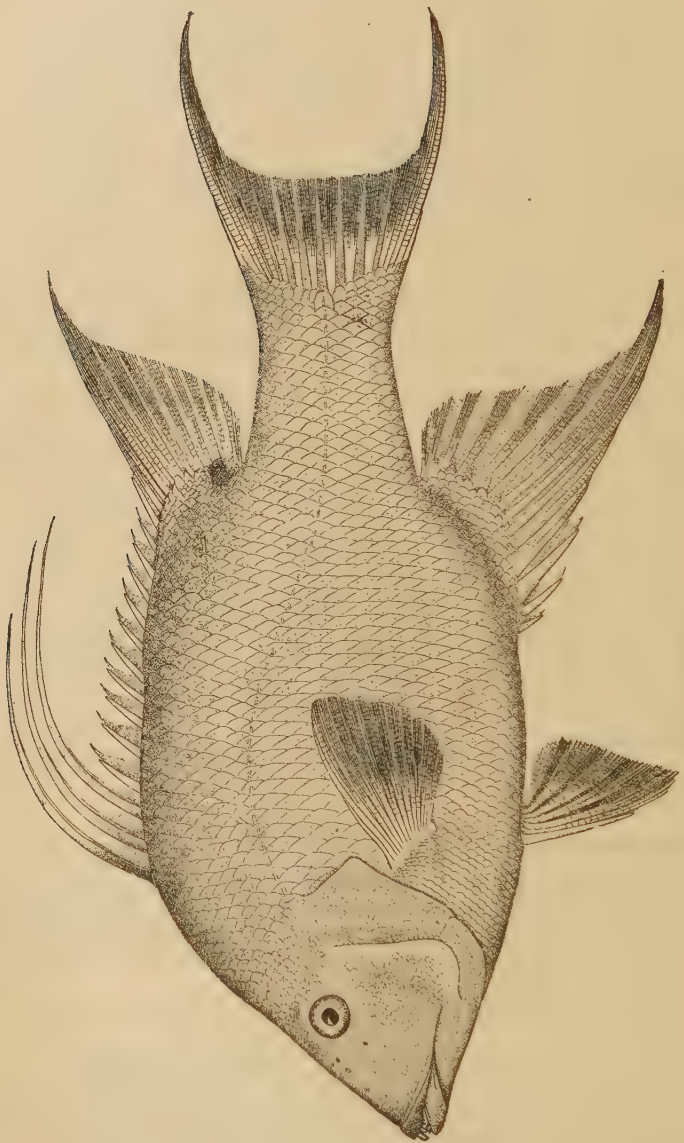

FIG. 16.—Hogfish (*Lachnolaimus maximus*).

uncommon, but the average weight is about 3 pounds. Fish weighing less than 1 pound are rarely seen in the markets.

Range.—Beaufort (N. C.) to West Indies; Bermuda; rare north of Florida.

70. **Sparisoma viride** (Bonnaterre). Parrot-fish.

This fish is occasionally caught by hook-and-line fishermen and is eaten to a small extent locally. Very little is known of its habits, and its value is very slight. It is a rich bluish-green in color. Maximum weight, 10 pounds; average, 2 pounds.

Range.—Bahamas and Florida Keys to West Indies; known from Bermuda, Jamaica, Porto Rico, St. Thomas, and St. Croix.

71. **Sparisoma flavescens** (Bloch and Schneider). Parrot-fish.

This parrot-fish is common in the vicinity of Key West. It is found in shallow water, chiefly on grassy bottom. Its color is mostly olivaceous, flushed with pink or orange. Its flesh is soft and rather poor, but it is used to a limited extent as food. Maximum weight, 1 pound; average weight of market fish, one-half pound.

Range.—Southern Florida to Brazil; found in the Bahamas and throughout the West Indies.

72. **Pseudoscarus guacamaia** (Cuvier). Green parrot-fish.

Of the large parrot-fishes this is the most common species found about Key West. In color it is mottled or barred with brown and blue; its teeth are green. It is not held in high esteem as a food fish, but is eaten sparingly in Key West. Maximum weight, 10 pounds; average, 1 pound.

Range.—Florida to Rio de Janeiro, Brazil; recorded from St. Augustine, Habana, Porto Rico, and Panama.

73. **Chætodipterus faber** (Broussonet). Spadefish; Angelfish.

The spadefish is found about Key West during most of the year and is especially common during the summer and fall. It is generally found close to shore in shallow water and travels in small schools. It is frequently taken in wire crawfish traps. After hauling crawfish traps daily for a long time and catching no spadefish at all the writer suddenly one day caught 18 of the fish in one trap, which illustrates their habit of schooling. The young (less than 1 foot long) are marked along the sides with six prominent black vertical bands on a silvery ground, but in the adult the entire body coloration is darker and the bands are less conspicuous. As a food fish it is held in high esteem, but the annual catch at Key West is not large. Maximum weight, 20 pounds; average, three-fourths pound. In Chesapeake Bay, where this fish is known as "porgee" and where small numbers are taken from spring until fall, they generally weigh between 3 and 12 pounds.

Range.—Cape Cod to Rio de Janeiro, Brazil; rare north of Chesapeake Bay; known from Cuba, Santo Domingo, Jamaica, Martinique, Porto Rico, and Panama.

74. **Pomacanthus arcuatus** (Linnæus). Black angelfish.

This beautiful species is rather common about Key West. It is found throughout the year but is not taken in large numbers. By visiting the markets a few may be seen at almost any time among the many species of fish held in the live cars. It is caught in wire crawfish traps and with hook and line. It is a food fish of some importance locally. Maximum weight, 6 pounds; average, 1½ pounds.

Range.—New Jersey to Bahia, Brazil; comparatively rare north of Florida; known from Tortugas, Cuba, Jamaica, Porto Rico, and Martinique.

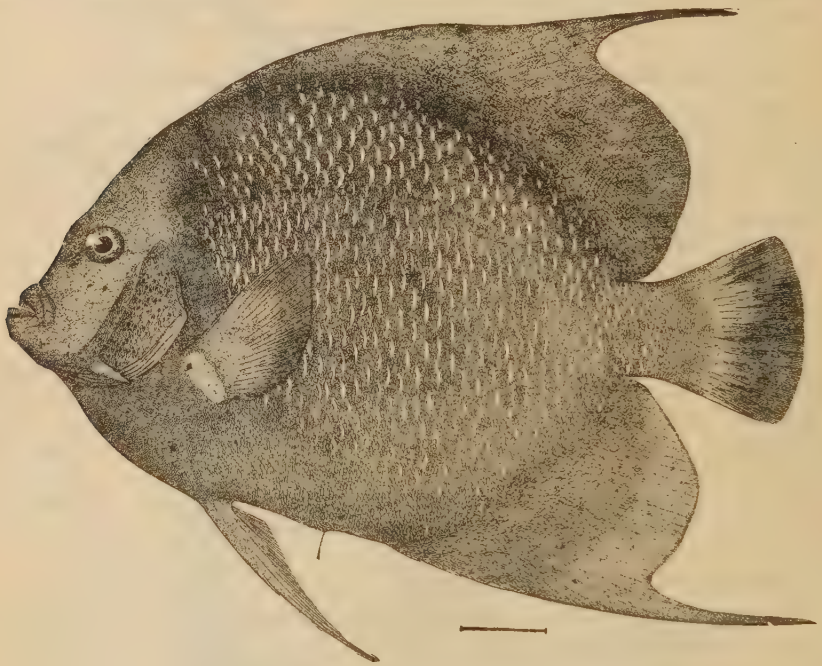

FIG. 17.—Black angelfish (*Pomacanthus arcuatus*).

75. **Angelichthys isabelita** Jordan and Rutter. Yellow angel; Blue angel.

The yellow angel is very similar to the black angel (*Pomocanthus arcuatus*) in size, local abundance, and food qualities. It is taken in wire crawfish traps or with hook and line. Maximum weight, 6 pounds; average, 1½ pounds.

Range.—Florida Keys to Brazil; known from Tortugas, Bahamas, Cuba, Jamaica, Lesser Antilles, and Bahia.

76. **Hepatus cœruleus** (Bloch and Schneider). Blue tang.

The blue tang is a very beautiful fish and is fairly common about Key West. It is generally taken in water from 15 to 25 feet in depth on grassy or rocky bottom. It is caught with hook and line or in crawfish traps, and is used for food purposes, but the annual catch is small. Maximum weight, 1½ pounds; average, one-half pound.

Range.—Usual range from the Florida keys to Brazil; recorded from Bermuda, Tortugas, Cuba, and Jamaica. The young are recorded from Woods Hole, Mass.

77. **Hepatus hepatus** (Linnæus). Tang; Doctor-fish.

This tang is rather common about Key West, where it is a food fish of slight importance. It is taken with hook and line, in crawfish traps, and with crawfish "grains." It is the most abundant of the tangs. Maximum weight, 2 pounds; average, one-half pound.

Range.—Usual range from North Carolina to Brazil; uncommon north of Florida; recorded from Beaufort, Charleston, Tortugas, Bermuda, Habana, Jamaica, Martinique, and Bahia. The young have been recorded as far north as Woods Hole, Mass.

78. **Hepatus bahianus** (Castelnau). Ocean tang.

The ocean tang is less common about Key West than is either the common tang (*H. hepatus*) or the blue tang (*H. cæruleus*). It is

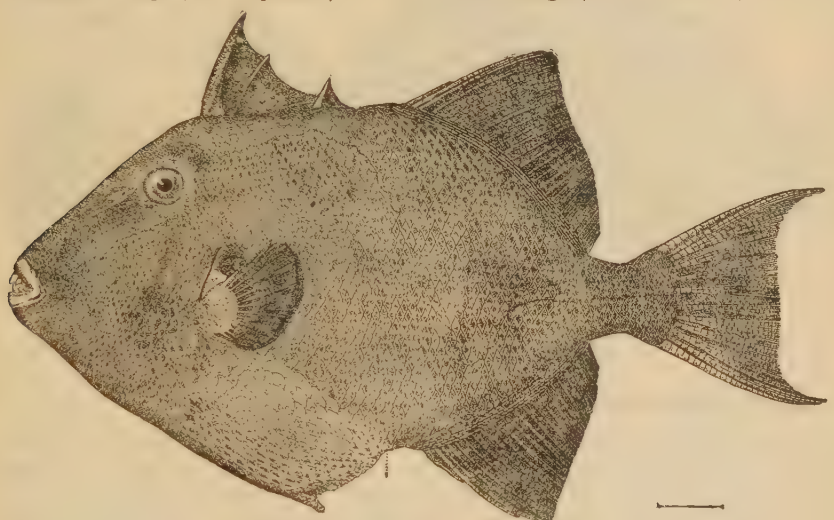

FIG. 18.—Turbot (*Balistes carolinensis*).

considered a good food fish but is seen only occasionally in the local markets. Throughout the West Indies this species is the most important of the tangs. Maximum weight, about 4 pounds; average, 1 pound.

Range.—Usual range from North Carolina to Brazil; rare north of Florida; found throughout the West Indies and common in Bermuda. The young have been recorded as far north as Woods Hole, Mass.

79. **Balistes carolinensis** Gmelin. Turbot; Trigger-fish; Leather-jacket.

The turbot is common about Key West, where it is caught with hook and line throughout the year. It is nearly always present in the live cars about the wharves, and is a food fish of importance locally. Maximum weight, 2 pounds; average, 1 pound.

Range.—Banquereau Bank off Canso (Nova Scotia) to West Indies; also found in Bermuda and the Mediterranean Sea; uncommon north of Florida; recorded from Massachusetts, Rhode Island, New Jersey, Chesapeake Bay, and North Carolina.

80. **Balistes vetula** Linnæus. Turbot; Trigger-fish.

This species is fairly common at Key West although somewhat less so than *B. carolinensis*, with which it is closely associated. Locally it is a food fish of some importance. The maximum size is not definitely known but is believed to be 2 or 3 pounds; average, 1 pound.

Range.—Usual range from Florida to West Indies; known from Bermuda, Bahamas, Jamaica, Ascension Island, and Porto Rico. The young have been recorded from Nantucket and Woods Hole, Mass.

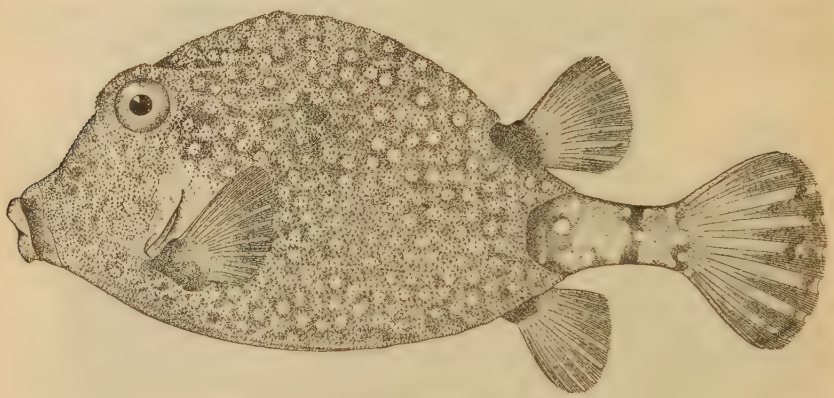

Fig. 19.—Cowfish (*Lactophrys triqueter*).

81. **Lactophrys triqueter** (Linnæus). Trunkfish.

This species is less common in the vicinity of Key West than either *L. trigonus* or *L. tricornis*. All three species are esteemed alike for food. Maximum size, 12 inches; average, 9 inches.

Range.—Usual range from North Carolina to Brazil; Pensacola; rare north of Florida; known from Bermuda and Porto Rico, where it is common. The young have been recorded from Katama Bay, Mass.

82. **Lactophrys trigonus** (Linnæus). Trunkfish.

This trunkfish is comparatively common about Key West and is taken throughout the year, hook-and-line fishermen catching this species while fishing for grunts, porgies, and other small fishes. It is sometimes found very close to shore amid sponges and other bottom growths. While using a 100-yard collecting seine near the island of Key West, about 15 adults of this species and *L. tricornis* were taken in one haul. It is a good food fish and is esteemed locally. Maximum size, 18 inches; average, 10 inches.

Range.—Usual range from North Carolina to Brazil; rare north of Florida. The very young, about 1 inch long, have been taken at Woods Hole, Mass.

83. **Lactophrys tricornis** (Linnæus). Trunkfish; Cowfish.

This species, sometimes called cowfish because of the two horn-like spines extending from the head, is about equally as common as *L. trijonus*, with which it is closely associated, and its habits and food qualities are very similar to the latter species. Maximum size, about 15 inches; average, 9 inches.

Range.—Usual range from Florida to Brazil and eastward to the Cape of Good Hope; recorded from Jamaica, Porto Rico, and Panama. The young have been taken in Katama Bay, Mass.

TABLE 1.—*Estimated catch of various species of fish landed in Key West during 1918 and caught within about 50 miles of the city.*

Species.	Pounds.	Species.	Pounds.
Amberfish	2,000	Parrot-fish	500
Angelfish	5,000	Pigfish	2,000
Barracuda	3,000	Pompano	545
Bluefish	16,614	Porgies	60,000
Bonito	350	Porkfish	10,000
Cowfish, or trunkfish	1,000	Sailors' choice	500
Groupers	200,000	Sheepshead	300
Grunts	150,000	Snappers:	
Hogfish	10,000	Mangrove	15,000
Houndfish	500	Red	9,000
Jewfish	15,000	Others	5,000
Jurel, runners, or jacks	20,000	Spadefish	1,000
Kingfish and cero [1]	373,500	Spanish mackerel [1]	1,734,200
Margate-fish	1,000	Tang	600
Moonfish	300	Tarpon	500
Mullet:		Turbot	4,000
White	27,313	Yellowtail	50,000
Striped	85,000	Miscellaneous	1,000
Muttonfish	25,000	Total	2,829,722

[1] Winter of 1918–19.

TABLE 2.—*Estimated catch and first value to the fishermen of various products landed in Key West during 1918.*[2]

Products.	Pounds.	Value.
Fish	2,829,722	$141,486
Spiny lobsters	345,518	33,335
Stone crabs	18,000	2,750
Turtles	150,000	15,000
Sponges	107,743	82,377
Clams	1,265	760
Conchs	2,000	100
Total	3,454,248	275,808

[2] The total catch given herewith varies somewhat from that listed in the Bureau of Fisheries statistical report for 1918, owing to the inclusion of the kingfish and Spanish mackerel catches for the season 1918–19 instead of for the year 1918 alone.

MULLET FISHERY.

The striped mullet (*Mugil cephalus*) is not caught in large quantities in the immediate vicinity of Key West, but it is one of the principal fish to be found in the local markets during the late summer. The season when this mullet is abundant generally lasts from July until November. In 1918 about 85,000 pounds, worth $3,000 to the fishermen, were landed during this period. The total catch

of striped and silver mullets (*M. curema*) landed in Key West during 1918 was 112,313 pounds, valued at $4,531.

The mullet is by far the most valuable fish caught in the State of Florida. During 1918 the catch on the west coast amounted to 25,023,666 pounds, worth $1,151,103, and on the east coast to 10,417,889 pounds, worth $397,147. In addition 86,285 pounds of salted roe, worth $17,593, were prepared, making the total weight of the fish 35,527,840 pounds, with a value of $1,565,843.

Mullets are found in large numbers along the entire coast line of Florida. They are particularly abundant in or about bays, rivers, or creeks, and the greater part of the catch is taken in brackish water within almost a stone's throw of land. Large numbers are found in the vicinity of Cape Sable, doubtless because the schools pass there going from one coast to the other, but among the Florida keys they decrease in numbers southward or as Key West is approached.

Nearly the entire catch of mullet is taken with gill nets of 1½-inch bar mesh. To make a catch in open water, two dories are used. The best type of dory has a platform in the stern, which is raised several inches from the bottom of the boat, and on this the net is stowed, payed out, and hauled in. It is essential that the woodwork of the boat, edges of the gunwale, and such places where the net is liable to touch be smooth, so that the net may not catch or impede operations. In each of the dories is placed a net 150 yards or more in length, properly corked and leaded, and with a staff at each end. When a school of fish is located, the boats come together and the fishermen connect their nets and from this point quickly surround the mullets, describing a semicircle and bringing the staffs of the nets together at another point. After sufficient time has been given for the fish to gill themselves each net is hauled aboard its respective dory and the fish are removed as they come aboard.

When mullets are caught in close quarters, such as in rivers or creeks, the operations of the fishermen are more simple and large catches are often made under such conditions.

A river bank often proves an effective aid in netting, as the fishes' chances of escape are considerably lessened by such a barrier. As a school of mullets advances along the shore the net staff is planted near the water's edge, and at the proper time the net is set around the fish and returned to the shore some distance up or down stream. Sometimes it is unnecessary to use all of the net, in which case the unused portion is distributed either within the inclosure or around the outside in order to effect additional obstruction for the fish. Often from 5 to 10 per cent of the fish escape by jumping over the outer edge of the net, and many others gain their freedom by swimming under the lead line at some point where it does not lie close on the bottom. It would be far more difficult to make large catches of mullets if they did not jump from the water or cause a disturbance at the surface, thereby betraying their presence. Catches made otherwise are the result only of chance. However, under ordinary conditions schools of mullet follow close along the shore and give evidence of their presence to the fishermen. A school swimming along at a speed of 2 or 3 miles an hour can be sighted in sufficient time for all preparations to be made for their capture. As a rule the fishermen lie in wait at selected points and sometimes remain for hours on the lookout for the fish. The mullet is a very elusive fish,

and at the slightest opportunity an entire school will evade capture or escape from a seine.

A large part of the fishing is done at night, fishermen selecting certain localities where the mullets are known to occur and where the water is free of snags. On moonlight nights the fish can be seen approaching, and on very dark nights they are located by their noisy splashes. Sometimes, also, a large net is set on a chance of surrounding a school that may be swimming deep, as they do on certain occasions. The fishery is rather uncertain, and sometimes the fishermen return without a fish. On the other hand, large catches are frequently made.

The greater part of the catch of striped mullets brought into Key West is taken at or near Cape Sable. During the fall of 1919 from 10 to 20 sloops and power boats operated in this vicinity. A run boat collected and iced the combined catch and made trips back and forth to Key West. Sometimes as many as 30,000 pounds of striped mullets are landed on one day in this locality, but generally the quantity is less.

In order to protect the mullet during the principal part of its spawning season, the State of Florida has enacted a law prohibiting the catching of striped mullet (*Mugil cephalus*) within the waters of the State from November 20 to January 20. During this closed season some of the fishermen resort to fishing for kingfish and Spanish mackerel.

Both fresh and salted mullets are shipped from Key West. Fresh mullets are packed in barrels, similarly to other species of fish, and the greater part of the catch is sent to points in this country. In dry-salting mullets the fish are split and several incisions made in the flesh in order that the salt may "take" better. They are placed in piles until part of the liquid drains off and are then packed in slack barrels topped with burlap. The greater part of the salted fish is shipped to Cuba.

Market fish generally range from 12 to 22 inches in length, with 16 inches as a fair average. The females, or roe fish, usually average about 2 inches longer than the males. It is not unusual to find large numbers of fish weighing 3 or 4 pounds each.

The silver mullet (*M. curema*) is abundant at Key West and throughout the Florida keys. It is common on both coasts of Florida. As the average length of this species is about 10½ inches, it is less sought after and of considerably less importance than the striped mullet. It is a good food fish, however.

On almost any day of the year schools of silver mullets can be found about Key West. They seem to prefer shallow water, 2 to 12 feet in depth, and as they move along the bottom is stirred up, probably in their search for food. An area of cloudy water surrounded by clear water invariably betrays the presence of silver mullets. They are captured in the same manner as the striped mullet, excepting that it requires a net of 1¼-inch bar mesh.

The fishermen distinguish the two species of mullet in the water by the way they jump, for, as a rule, the striped mullet jumps clear of the surface, while the silver mullet merely flips its tail out of the water. There are exceptions, however, when most or all of a school of silver mullets will jump out of the water simultaneously. This

jumping in unison has not been observed with the striped mullet, and only one or two individuals of a large school appear to leave the water at the same time.

Although the silver mullet is abundant, the catch landed in Key West is small and the greater part of it is dry salted and shipped to Cuba.

KINGFISH FISHERY.

Kingfish (*Scomberomorus cavalla* and *S. regalis*) are caught in southern Florida from early November until late March. The season usually covers the same period as that of the Spanish mackerel, but the fishing is somewhat more uncertain. In some years very few kingfish are caught before December 1, but it is the custom of the fishermen to commence operations about November 10. The catch of kingfish in Florida for the season 1917–18 is given in the report of the Commissioner of Fisheries for 1919, Appendix X, as follows:

TABLE 3.—*Catch of kingfish in Florida for the season 1917–18.*

West coast.		East coast.	
County.	Pounds.	County.	Pounds.
Pinellas	25,537	Palm Beach	1,298,161
Manatee	42,367	Broward	300
De Soto	3,011	Dade	973,331
Monroe	394,945		
		Total	2,271,792
Total	465,860		

The total catch for both coasts was 2,737,652 pounds. The entire catch of Monroe County was landed at Key West. Monroe County includes a portion of the extreme southwestern part of Florida and the Florida keys, which extend southwestward from the mainland forming the line dividing the Atlantic Ocean and the Gulf of Mexico. The major part of the fishing is done on the Atlantic side of the keys. The kingfish, therefore, are found in greatest abundance from Palm Beach County to Key West.

In this country the kingfish fishery is confined almost entirely to Florida, the only other State where it may be considered as of importance being North Carolina, which reports a catch of 211,781 pounds for the season of 1918. Off the Carolina coast kingfish are caught from May until October or during the months when they are not found in Florida.

TABLE 4.—*Catch of kingfish, by months, taken along the Florida keys and landed at Key West during the seasons from 1918 to 1920.*

Month.	1918–19	1919–20
	Pounds.	*Pounds.*
November	1,000	25,000
December	25,000	28,000
January	168,200	248,000
February	154,300	45,000
March	25,000	103,000
Total	373,500	449,000

The first two fish of the 1918–19 season were landed at Key West on November 20, 1918, and the fishing ended abruptly on March 10, 1919, owing in part to the breakdown of the city's only ice plant.

The first fish of the 1919–20 season was landed at Key West on November 6, the second on November 7, and the third, weighing 30 pounds, on November 10. Favorable weather during March permitted an unusually good catch for that month. The fishing ceased on March 25.

For kingfish fishing a seaworthy power boat is of first importance. The majority of those seen in Key West range in length from 24 to 50 feet. The most serviceable boats are of the half-cabin type, for on these sleeping accommodations may be provided and the boats are in many ways more satisfactory. A few open boats generally are employed for near-by fishing. Sometimes sailing vessels are seen, but without auxiliary engines they prove rather unsuitable except under unusually favorable weather conditions, as the speed of the boat must be evenly regulated in order to travel in any direction the fish may choose to take. As kingfish die soon after capture the fish well, if present in the boat, is not utilized.

With the exception of the boat the necessary equipment for kingfish fishing is very simple and inexpensive. A small supply of heavy cotton trolling lines, wire leaders, and metal squid hooks are all that is needed. After the first fish has been landed by the bare squid strips of flesh and skin are cut from the belly of this fish and are used as bait for other fish.

At least two men are required to man a boat—one to attend exclusively to fishing and one to manage the boat and fish when opportunity affords. Two or more lines are trolled, according to the size of the boat. Slipknots are made on the lines, and when one of these pulls out it is a good indication that a fish has taken the hook. After hauling in fish for several hours this fishing seems more like work than sport, but an element of excitement and expectancy is always present.

It is not unusual for a boat to cruise about for most of a day without catching a fish, and often the catch scarcely pays for the fuel consumed, but in the long run the fishing is usually profitable, as a catch of several thousand pounds now and then more than offsets the days of loss.

The fish usually range in weight from 4 to 40 pounds. Occasional examples reach 50 pounds or more, but such fish are rare. During the early part of the season when fish are scarce the few taken as a rule are large, weighing from 10 to 40 pounds, but when the schools strike in the weight of individual fish usually varies from 4 to 15 pounds. Fish of about the same size are generally found in a school, as it was observed that certain boats brought in fish weighing from 5 to 8 pounds, others brought fish weighing 6 to 10 pounds, and still others had fish weighing 8 to 12 pounds, etc. It is probable that each of these boats caught their fish from a single school.

A large part of the kingfish catch is exported to Cuba or consumed locally. Some shipments are made to points in this country where the kingfish, however, are not regarded as favorably as the Spanish mackerel. The Key West markets are never glutted, and the annual catch is easily disposed of. The fishermen receive a uniform price

for their fish, as the rate is fixed at the beginning of the season. During the 1919–20 season the price was the same as for Spanish mackerel, 6 cents per pound. The retail price is generally about 25 cents per pound.

The kingfish is an excellent food fish when fresh, and its few bones and good flavor place it in great demand in Florida and Cuba. It is a fine game fish and is eagerly sought after by sport fishermen.

SPANISH-MACKEREL FISHERY.

On the Atlantic coast the Spanish mackerel is found from Monhegan, Me., to Brazil and in the Gulf of Mexico. It is taken in commercial quantities south of Sandy Hook, N. J. As a food fish it is held in high esteem and commands a good price at all times. The retail price during the last few years has ranged from 25 to 50 cents a pound.

It is only in recent years that the migrations of the Spanish mackerel have been partly understood. Less than 50 years ago it was not known where the fish spent the winter months, and it was only from April until early November that they were caught and brought to market. At that time Spanish mackerel apparently were not known to be in abundance in the waters of southern Florida during the winter.[2]

The following table shows the quantity of Spanish mackerel taken in 1880, by States, and the total catch for the United States:

	Pounds.
Massachusetts	60
Rhode Island	2,000
Connecticut	1,200
New York	25,000
New Jersey	200,000
Maryland	18,000
Virginia	1,609,663
North Carolina	10,000
South Carolina	1,000
Eastern Florida	500
Gulf of Mexico	20,000
Total	1,887,423

It is noteworthy that at the present time Spanish mackerel are caught and shipped to market in greatest abundance from November to March or during the months when 50 years ago the fish were seldom seen. It is now believed that these fish migrate southward and spend the winters in warmer waters. In 1880 the total catch for Florida and the Gulf of Mexico was recorded as only 20,500 pounds. The entire catch for the United States in that year only slightly exceeded the Key West catch for 1918–19 (1,734,200 pounds), and it was less than the Key West catch for 1919–20 (2,322,000 pounds). The distribution of the mackerel along the coasts of Florida is shown by the following statement giving the catch for the season 1917–18:

[2] The Fisheries and Fishery Industries of the United States. By G. Brown Goode and associates. 1887. Section V. History and Methods of the Fisheries, Vol. I, pp. 543–552.

East coast counties:	Pounds.
St. John	1,510
St. Lucie	696,721
Palm Beach	1,493,319
Dade	870,415
Total	3,061,965
West coast counties:	
Escambia	124,076
Okaloosa	147,297
Bay	508,784
Calhoun	19,994
Franklin	53,809
Wakulla	750
Levy	23,950
Pinellas	8,176
Manatee	147,463
De Soto	278,355
Lee	57,971
Monroe	2,065,276
Total	3,435,901

The total catch for the State of Florida was 6,497,866 pounds, with a value to the fishermen of about 6 cents a pound. Practically the entire catch of Monroe County was landed at Key West.

During each of the seasons 1918–19 and 1919–20 the first commercial catch of Spanish mackerel was brought in to Key West on about November 20. The season 1918–19 ended March 1, and only a few fish were caught after that date. This, together with the small catch for February, was partly due to a shortage of ice caused by the disability of the city's only ice plant. The catches, segregated according to months, were as follows:

TABLE 5.—*Catch of Spanish mackerel, by months, landed at Key West during the seasons from 1918 to 1920.*

Month.	1918–19	1919–20
	Pounds.	*Pounds.*
November	154,000	7,200
December	345,000	850,000
January	1,149,200	998,800
February	86,000	170,000
March		296,000
Total	1,734,200	2,322,000

Gill nets and purse seines are used for catching Spanish mackerel in the vicinity of Key West. A few are caught with trolling lines, but the catch from this source is small. At other points along the coast, particularly in Virginia and North Carolina, a large part of the catch is taken with pound nets. The gill net is more extensively used than the purse seine. The usual net is 20 feet in depth, 150 to 175 yards in length, having a stretched mesh of 3⅜ to 3⅝ inches built of 6-thread cotton seine twine and tarred. In the fishery several shorter nets are joined together to form one 500 to 1,800 yards in length, according to conditions and the facilities of the boat.

The boats employed are usually from 30 to 50 feet in length, gasoline driven, and of the open or half-cabin type. In order that fishing may be done at night, a searchlight is carried on the bow. Most of

the fishing is done between sunset and sunrise, owing to the fact that many more mackerel gill themselves in the darkness than in the daylight, when they are able to see the net.

Gill netting appears to be an effective method of fishing, as a crew of two men often makes large catches. Some of the fishermen work independently, owning their own equipment, while others are attached to an individual or company and are supplied with the necessary boats and nets. At least one company that employs a small fleet of boats has a houseboat, which is anchored in a protected locality near the scene of operations and on which the men eat and sleep. Racks for drying the nets are built on the roof of the houseboat.

The schools of fish are found at night by searchlight. When located, the mackerel are surrounded as rapidly as possible, and the direction of the net is indicated by lanterns mounted on cork floats placed at convenient intervals along the cork line. After the fish have been trapped the dories encircle the net, splashing the water to frighten the fish into gilling themselves. Sometimes the boats enter the inclosure to agitate the fish. As the bottom of the net is entirely open the fish could easily escape by sounding, but apparently the greater part of them remain at the surface, where they either gill themselves in the net or succeed in jumping over the top.

During the 1919–20 season Key West had only one purse-seine boat, but several vessels came down from the mainland to operate in the vicinity of the keys. The local vessel was 90 feet in length with a 20-foot beam, and carried a crew of about 15 men. It was formerly schooner rigged, but it had recently been overhauled by having its topmasts removed and an auxiliary engine installed. The mackerel purse seine is about 600 yards in length. The upper part of the seine near the cork line is made of $3\frac{3}{8}$ to $3\frac{3}{4}$ inch stretched mesh, while the bunt is of 3-inch mesh.

Purse seining is an effective method of fishing for Spanish mackerel, and large catches are often made. However, during the 1919–20 season the gill netters, because of their greater number, took the major part of the catch.

The advantages of gill netting over purse seining, especially to fishermen with small capital, are: (*a*) The gill netters can operate with a small power boat and with a crew of two or three men, whereas the purse seiners require a larger boat and more men. If one company owns a number of gill-netting boats, these can operate in several localities at the same time, and thus cover more territory with the reasonable assurance that one or more of the boats will make a good catch. (*b*) The cost of equipment and operating expenses is smaller for the gill netters than for the purse seiners. When fishing some distance from Key West, the catch of the gill netters is collected by a run boat, which brings the fish to the city and saves the fishermen much valuable time, and in addition the run boat transports necessary supplies and food. The purse-seine boats generally bring their own fish to market and restock for the next trip. On the other hand, the purse seiners sometimes make large catches that prove very profitable.

In packing mackerel for shipment the fish are iced in barrels containing 200 pounds net, and in shipping they are removed from the market as quickly as possible to make room for subsequent receipts. The fish are delivered by the fishermen with the entrails removed, and

at the markets they are washed, weighed, and immediately packed for shipment. During the height of the season as many as 100,000 pounds of fish must be disposed of within one day in one fish house, and considering the relatively few men who execute this work it can only be accomplished by the speed, dexterity, and cooperation of the entire force.

At times as many as 10 small boats are lined up at one of the fish wharves waiting to dispose of their cargo. In unloading the fish a 2-bushel basket is lowered into the boat, filled, hoisted to the dock, and dumped into a wire-meshed, semicylindrical basket that rests in a tub of water. In this basket they receive a superficial washing by being raised and lowered several times in the tub of water. The fish are then dumped on a large table, from which they are thrown on a scale and weighed in 100-pound lots. A barrel with broken ice on the bottom of it is always in readiness near the scale, and the fish are packed so as to form alternate layers with the ice, which is added as necessary. When 200 pounds of fish have been placed in a barrel it is rolled away, the remaining space being filled with ice well tamped. A wooden cover is nailed on, the barrel is properly consigned, and is then ready for shipment.

Most of the mackerel are shipped to points east of the Mississippi River, New York being the principal market. As a rule a glut seldom occurs on the market, but when heavy catches are received at Key West and other points in Florida simultaneously the price tends to drop until the heavy run is over. The fishermen receive a uniform price throughout the season, which in 1919–20 was 6 cents per pound to fishermen owning their own equipment and 3½ cents to those who were furnished equipment by the dealers. When the gill-net fishermen deliver their catch to the run boat that visits the fishing grounds, a slight reduction—usually one-half cent a pound—in the price paid is made. To the fish dealers the mackerel bring the highest prices in November and March, when catches usually are small. For a number of seasons past a representative from Fulton Market, New York, has been stationed in the largest fish house in Key West, where he supervises the packing and shipping of all fish consigned to his market. He purchases probably one-half of the Key West catch of mackerel. The quantity of mackerel sold to the local trade in Key West is negligible.

Florida has the only special fishery for Spanish mackerel, although in North Carolina about 100,000 pounds were caught with gill nets during 1918. From New Jersey to North Carolina it is caught in pound nets along with other species of fish. In Chesapeake Bay the first fish are caught in pound nets during the last week in May or the first week in June. The fish leave the bay the latter part of September or early in October.

SPINY-LOBSTER FISHERY.

The Florida spiny lobster (*Panulirus argus*) differs considerably from the northern lobster (*Homarus americanus*), the chief differences visible at a glance being the very long legs, the long whiplike antennæ studded with spines, the spines of the cephalathorax, or body, two of which protrude over the eyes like a pair of horns, and the absence of the great claws. Its flesh has a delicate flavor, and it

is said to equal that of the northern lobster. Aside from being an important food for man, it is extensively used as bait by the hand-line and fish-trap fishermen. Besides the name "spiny lobster," this crustacean is known as "crawfish," "sea crawfish," "langouste," and "rough, thorny, or rock lobster." The name in general use among the fishermen is crawfish, but dealers ship the animal under the name "Florida lobster." Spiny lobster is perhaps the most suitable name, but for the sake of brevity the name crawfish has been most generally used in this paper.

Within recent years the crawfish has found an important place in the fishery industry of Key West. Shipments to Cuba and cities of the eastern United States have steadily increased during the past decade, whereas prior to 1910 few crawfish, if any, were sold outside of the State.

For many years the crawfish has found a ready sale in the city of Key West, and the price has been as low as 25 to 50 cents for one dozen, according to the season and the weather. The retail price during 1922 ranged from 75 cents to $3, with a general average of $1.50 a dozen, depending upon the available supply. They are sold at retail by the piece or by the dozen and are seldom weighed.

The average market size throughout the year is 9 to 10 inches in length, exclusive of the long antennæ, and the weight of a 9-inch crawfish is about 1 pound. The males grow larger than the females, and adult males are heavier than females of the same size, partly because of the longer legs. A comparison of the following weights indicates the difference: Males, 8 inches, 10½ ounces; 9 inches, 1 pound 1 ounce; 11 inches, 2 pounds. Females of these same sizes weighed 10½ ounces, 15½ ounces, and 1 pound 11 ounces, respectively. During two years of intensive market observations it was found that the weights of about 99 per cent of the crawfish sold for food would fall between the extremes of one-half and 6 pounds. Very small crawfish are common in their natural habitat, but they are used only for fish bait. Crawfish weighing more than 6 pounds are rarely seen. The largest of which the Bureau of Fisheries has an authentic record was caught the latter part of January, 1922, with hook and line in 8 fathoms of water about 8 miles off the coast of Sarasota County, Fla. This specimen, which weighed over 8 pounds when caught and the total length of whose body and tail was 17 inches, is now in the United States National Museum collection.

The crawfish is found close to shore, and most of the fishing is carried on within a mile of land. Rocky reefs and their adjacent territories are the most favorable fishing grounds. Its range in the United States extends from Beaufort, N. C., to the Florida Keys, principally on the Atlantic side, and among the islands of the Dry Tortugas. However, it is not numerous enough north of Miami, Fla., to be of commercial importance. Large numbers are reported from the Bahama Islands, and it is known to occur as far south as Rio de Janeiro, Brazil. A spiny lobster resembling *P. argus* in general appearance is found on the Pacific coast, but it is of a distinct species.

The same type of boat is employed in the spiny-lobster fishery as that used in the hand-line fishery. Fishing lines are always kept aboard, so that if crawfish fishing proves unsuccessful the fishermen may return to port with a fare of fish. All boats in the vicinity of

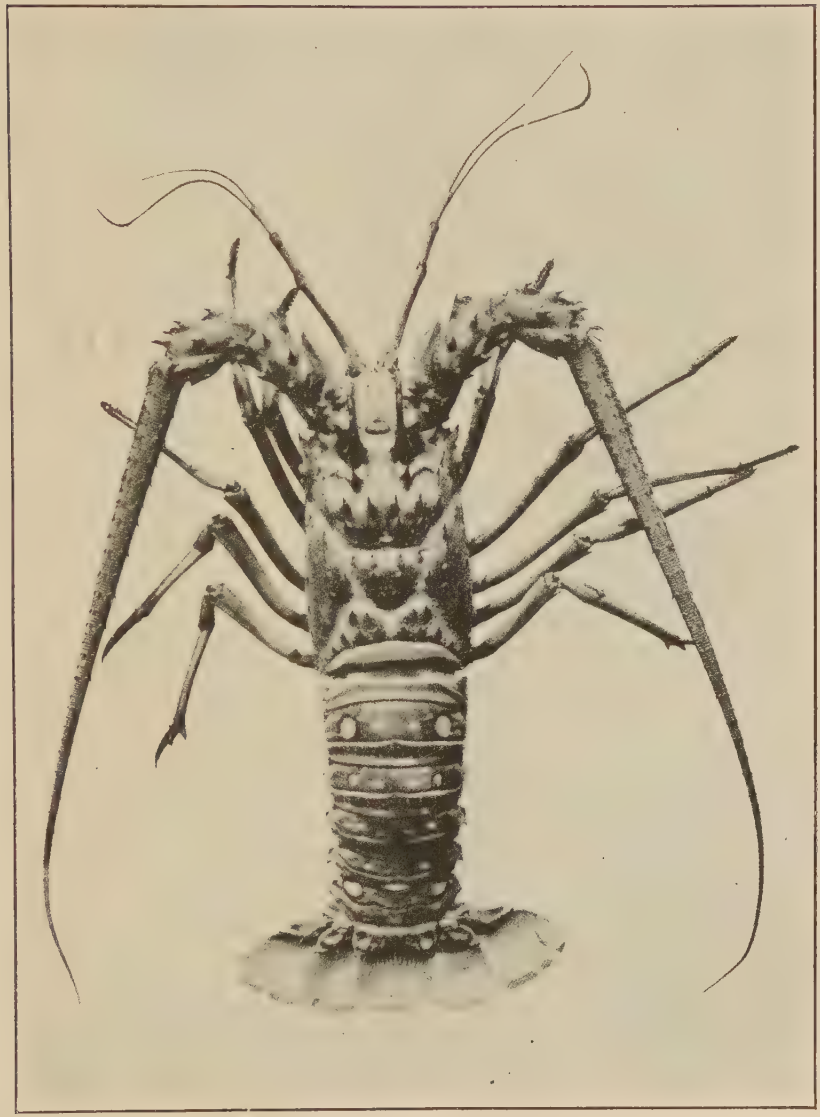

FIG. 20.—Spiny lobster (*Panulirus argus*).

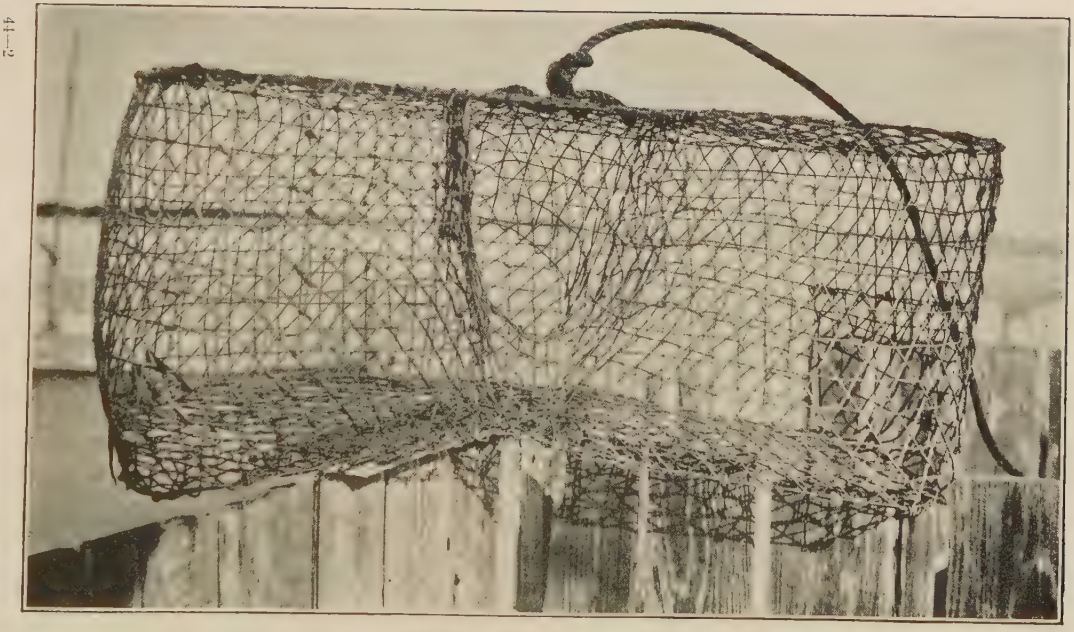

FIG. 21.—Spiny-lobster trap, also utilized for catching stone crabs and fish.

FIG. 22.—Bulley net used for catching spiny lobsters.

Key West are equipped with fish wells, which, according to their size, may accommodate from several hundred to about 1,000 crawfish. When using the bully net or the grains a small flatboat is utilized in making the catch. The typical flatboat has a rather blunt bow, to afford sufficient room for standing. This is an important feature, as the operator always works in the extreme bow of the boat. Some flatboats are equipped with a small fish well, but this is not absolutely essential for crawfish fishing, as the catch can be deposited from time to time in the well of the larger boat. Crawfish fishermen often remain away for a week or more at a time and seldom leave port with less than a 10-day supply of staple food products.

Three methods are employed in catching the crawfish—trapping, "bullying," and striking. The method of trapping crawfish differs in no special way from that used in trapping the northern lobster (*Homarus americanus*), except that the trap itself is of a distinct type. The traps are handmade and are built of heavy galvanized wire. It requires considerable skill to manufacture a good trap, and in 1919 only one person made them for sale. The price at that time was $7. The trap is somewhat elbow-shaped and measures about 4 feet in length, 2 feet in width, and is 1¼ feet in depth. Crawfish, crabs, and fish can enter through an opening made in the center of the vertical apex. The traps are baited with fish and placed in favorable localities, generally within 1 mile of the shore. Buoys are usually attached to the offshore traps, but are dispensed with when fishing is done near land in shallow water. The traps are lifted every morning when the weather is favorable. The crawfish are taken out through a small door located on the upper part of the trap. Stone crabs and fish are often caught along with the crawfish; the crabs and larger fish are retained for market, while the smaller fish are used to rebait the traps. The principal advantages of trap fishing for crawfish are (*a*) one fisherman can work alone and independently, (*b*) the traps will fish in deep water where at times most of the crawfish migrate, and (*c*) fishing can be done during moderately heavy weather when other methods of crawfish fishing are curtailed.

While trap fishing is somewhat of a success on a small scale, as yet no one has specialized in this method. It is not uncommon to catch from 6 to 15 good-sized crawfish in one trap over night, while 4 per trap might be considered a very fair average. The fishermen do not lift their traps during periods of rough weather, and at times they remain down for a week or more. When lifted at the termination of such a period, they do not contain many more crawfish, if any, than if they had been down but one night, and it is evident that some of them must escape after being trapped. According to the fishermen, the disadvantages of trap fishing are the high cost of the traps and the labor required for making them, the frequent repairs that are necessary when corrosion begins, the loss of traps through storms, theft, or otherwise, and the fact that they must continually be baited with fish.

"Bully" fishing for crawfish is done chiefly at night. Two men generally work together, but some fishermen work alone and independently. Besides the small flatboat, the necessary equipment consists of a bully net and a lantern. The bully net resembles a long-handled dip net, but differs in having the iron hoop placed at

right angles to the pole. The pole is 12 feet or more in length, and the pocket of the net is about 24 inches deep. The lantern is placed in a glass case as a protection from the wind and is set in the bow of the boat.

When a "bully" fisherman discovers a crawfish crawling on the bottom he gives his partner directions for maneuvering the boat to a point of vantage, whereupon the bully net is carefully but swiftly placed over the crawfish. With due caution the animal can be approached without its becoming alarmed, but upon the slightest touch of the net it makes a desperate effort to escape. The hoop of the net must entirely surround the crawfish and touch upon even bottom or the animal will escape. When the crawfish finds that it can not escape beneath the hoop it thrusts itself back into the bunt of the net, and it is then that the fisherman raises the net to the surface with the crawfish secure in the bunt, which hangs over the side of the hoop. A fisherman working alone must push his boat along with the bully pole and is at a great disadvantage, especially in a strong tide.

During the course of a night one boat may capture as many as a thousand crawfish, but frequently only a few dozen are taken. The average catch probably ranges between 50 and 100.

Striking is perhaps the most productive as well as destructive method of catching crawfish. The weapon used, known locally as the "grains," is a two-tined barbed spear, each prong being about 3 inches long. By means of a ferrule it fits on the end of a pole 15 feet or more in length. This fishing is pursued in the daytime and when the sea is smooth. The crawfish, which can usually be distinguished by its long whiplike antennæ protruding from the shelter of a rock or sponge, is located by the use of a water glass.[3] By touching the antennæ the animal is usually frightened from its shelter, and at the crucial moment it is speared with the grains. Many badly injured animals escape and soon die, while most of those caught do not survive long, and if the fishermen remain out too long a part of their catch is liable to spoil and can not be used as food. This method of fishing, therefore, is destructive and wasteful.

Several Key West dealers ship relatively large quantities of crawfish out of the city. The principal markets are hotels and restaurants located in Miami, Jacksonville, Atlanta, Washington, Philadelphia, New York, and Boston. The restaurants utilize the crawfish to prepare various fancy dishes calling for lobster meat other than in the shell. For long-distance shipments two methods are employed in preparing crawfish—some are shipped alive and some are shipped after being cooked.

When shipping live crawfish they are carefully packed in sugar barrels. They must not be overcrowded, and therefore not more than 6 dozens are placed in one container. A substantial layer of ice is first placed in the bottom of a barrel, and on the ice is put a layer of sponge clippings—a waste material obtained when prepar-

[3] A water glass such as is used in the Key West sponge and crawfish fisheries is simply a wooden bucket, the bottom of which has been replaced by glass, all joints being made water-tight. It is used when the water is choppy and the bottom could not otherwise be seen. The operator holds it in the water with one hand, thrusts his head into the pail, and with the other hand holds his implement of capture, whether it be sponge hook or grains. In very rough water it can not be used because of the violent action of the boat.

ing sponges for the market. The crawfish are then placed in a single layer on the sponge and covered with more clippings and ice. Thus, when completely packed, a barrel contains alternate layers of ice, sponge, crawfish, and sponge. The sponge clippings are used to absorb moisture and to keep the crawfish from direct contact with the ice. The barrels are conspicuously marked "re-ice," and it is sometimes necessary for transportation companies to re-ice a shipment several times when it is consigned to a distant point.

During the experimental stage of shipping live crawfish many of them were received in a spoiled condition, and it was thought that shipments could not be made with profit. It developed, however, that the most unsatisfactory shipments were caused by poor packing, and by experimenting the system just described was established and reduced losses to a minimum. It is very important that the crawfish be handled with great care from the time they are removed from the water until they reach their final destination. No injured crawfish are shipped alive, which fact excludes all those captured with the grains.

More crawfish are shipped in a cooked state than alive. More labor is required to prepare cooked crawfish, but shipping losses are very small and considerable packing space is saved by the elimination of the waste parts of the animal. Crawfish that are to be shipped in the cooked state are prepared as follows: The live animals are placed in a steam cooker and cooked until they are sufficiently well done to be eaten. After they have cooled sufficiently to be handled with unprotected hands the abdomen, or tail, is removed and the remainder of the animal is thrown away. The tail is split open and the meat is removed from the shell. Four or five tails are placed in a No. 2 friction-top can, which is perforated with small holes to admit air. These cans are then packed in a slack barrel, iced as in the case of fish, and are ready for shipment. A standard barrel contains 64 cans of 105 pounds net weight, representing the meat of 24 dozen crawfish. The barrels, however, vary somewhat in the weight of the crawfish they contain. One dealer dispenses with the cans entirely and packs the tails, without removing the shell, in barrels with an abundance of broken ice. He has used this method for a number of years with satisfactory results.

The trap and bully furnish the most select crawfish and the only ones that can be retained in captivity or shipped alive for long distances. Fortunately for the industry, many of the fishermen and most of the dealers look with disfavor upon the "striking" of crawfish. The abdomen or tail of a "struck" crawfish is usually removed from the body before it is cooked, and by this operation much space is saved in the cooking kettle or pot. Owing to the rapid deterioration of the flesh it is a question, however, whether this practice is a good one, as crawfish, lobsters, and crabs are in the best condition when killed in the cooking process.

No crawfish are canned in Key West at the present time (March, 1920). Several attempts to do so have been made during the past 10 years, all of which failed because of the tendency the meat has of turning dark. It is believed, however, that by experimenting along these lines and carefully studying the methods used in canning shrimp, lobsters, and crabs that the crawfish can be successfully

canned. It is very probable that properly canned crawfish could readily establish itself on the market.

Because of the large numbers of crawfish used for fish bait it is difficult to estimate the annual catch with much exactness. The approximate catches made in previous years are as follows: 1895, 157,500 pounds; 1897, 161,500 pounds; 1902, 57,664 pounds; 1918, 345,518 pounds. During the month of December, 1918, shipments sent out under the trade name of "Florida lobsters" totaled about 500 barrels. This amount established a record up to that time, but this record was exceeded several times during 1919. During the year 1919 about 360,000 crawfish, weighing approximately 375,000 pounds, were caught. Of these about 40 per cent were shipped, 40 per cent were consumed locally, and 20 per cent were used as bait by the fishermen. On September 10, 1919, a severe hurricane visited Key West, wrecking many of the boats and paralyzing the fishing industry for several weeks; but for this incident the catch of crawfish would have reached 400,000 pounds.

The crawfish is taken at all seasons of the year, but the period of greatest abundance is from November to June. Most of the spawning occurs during the spring and summer, but occasional eggbearers are found as late as early winter. Unlike the northern lobster (*Homarus americanus*), whose eggs are carried for about 10 months before hatching, the incubation period of the eggs of the Florida spiny lobster is only about three weeks.

Large numbers of crawfish congregate along the shores during the spring for the purpose of spawning, and they are easily captured there. To conserve the supply of crawfish, the State of Florida has enacted a law, approved May 23, 1919, and effective for the first time during 1920, protecting the crawfish during the principal part of its spawning season. The text of this law is as follows:

SECTION 1. It shall be unlawful for any person, firm, or corporation, or association of persons to take or catch any salt-water crawfish from the waters of the State of Florida for commercial purposes, or to have in their, or its, possession between the first day of March and the first day of June of any year: *Provided*, That salt-water crawfish may be caught or taken at any time for purposes of bait, for catching fish, or for purposes of propagation or research by any State or biological station.

SEC. 2. It shall be unlawful for any common carrier, agent, or employee of such carrier to receive for carriage or permit the carriage of any such crawfish between the first day of March and the first day of June of any year.

SEC. 3. Any person, persons, firm, or corporation, or association of persons violating any provision of this act shall be deemed guilty of a misdemeanor, and upon conviction shall be punished by a fine of not more than two hundred and fifty ($250) dollars, or by imprisonment in the county jail for not more than six months, or both.

The future of the crawfish industry appears to be promising. A large commercial enterprise could hardly be supported by the demands of southern Florida, but there is almost unlimited opportunity for expansion by introducing this delicacy into the hotel and restaurant trade and even as a familiar object in the fishmonger's store. The crawfish has already been put to the test and has been accepted by some of the foremost epicures in this country.

At the present time one of the chief drawbacks to the crawfish industry is the irregularity of the supply owing to weather conditions. During windy weather, with its resultant high seas, it is impracticable to bully or strike crawfish and the small catch of the

traps at such times is usually insufficient to supply even local demands. Thus it happens that at times dealers are unable to secure a good supply for one or two weeks at a time. While crawfish can be retained in live boxes for long periods of time, it appears that dealers do not make a practice of accumulating large supplies.

STONE CRAB.

The Florida stone crab (*Menippe mercenaria*) is the only species of crab that is of commercial importance in southern Florida. It is found from Beaufort, N. C., to Matagorda Bay, Tex., and has been recorded from Yucatan. A closely related species (*M. nodifrons*) is found from Cuba throughout the West Indies to Brazil, with a single record from Cameron, La.

Judging from the small numbers to be seen in the markets throughout the year, the stone crab is not found in great abundance. The flesh of this crab may, indeed, be considered a delicacy, and it is doubtful if there is any animal caught among the Florida keys that surpasses it in excellence. The fishery is pursued almost entirely with traps, although a few crabs are caught by hand and with nets. Stone crabs do not necessarily inhabit rocky places, and they are frequently found on bottoms of sand, marl, or clay, and among corals, sponges, and other bottom growths.

These crustaceans are caught throughout the year, but the most favorable fishing obtains during February, March, and April. They are found rather near the shore and generally not farther than 1 mile from land. Very few fishermen specialize in catching crabs, and most of those caught are taken incidently with crawfish. During periods of stormy weather when the traps are inaccessible the markets are sometimes without crabs. Unlike the crawfish, stone crabs are not shipped out of the State, but during the winter small numbers are supplied to seaside hotels in southern Florida.

When the weather is favorable the Key West catch varies from about 10 to 50 dozens a day during the winter and spring season, but no doubt more could be caught if they were more keenly sought after. The estimated annual catch of crabs is recorded for the following years: 1895, 4,680; 1902, 8,160; 1918, 18,400; and 1919, 22,000.

Small crabs, measuring about 3 inches in width across the carapace, sell at retail for about $1 a dozen, while those 4 or more inches in width bring from $1.50 to $2. The size of the claws, rather than the size of the body, determines the value of the crab, for the body meat is not eaten except in the very largest ones, because of the tedious process of picking out the edible parts. Large crabs with small claws are therefore classed with the small animals, and those without claws are returned to the water without injury. It is not unusual to find large crabs with claws weighing nearly half a pound each. The maximum size attained by the stone crab is about 6 inches in width across the carapace. Since they have no large lateral spines, such as the blue crab has, an individual of this size with its great claws is larger than might be supposed. A crab having a carapace 4.8 inches in width was found to weigh 13 ounces, and one of 5.1 inches weighed 1 pound and 3 ounces. These specimens both possessed claws of normal size.

Stone crabs do not live long out of water and on a warm day probably would not survive more than several hours. When dead they deteriorate very rapidly, and in preparing them as food they should by all means be killed in the cooking process. Stone crabs, however, can be held in captivity for a long time, as a number were retained in pens at the Key West biological station for over two years, when they were finally lost in a hurricane.

TURTLE FISHERY.

Key West is one of the principal markets for marine turtles in the United States. Three species are seen in the markets—the green turtle (*Chelonia mydas*), the loggerhead (*Thalassochelys caretta*), and the hawksbill (*C. imbricata*).

The green turtle is by far the most important, the loggerhead is considered inferior and is eaten only by the fishermen, while the hawksbill is scarce and used only for its shell. Most of the turtles are brought in by foreign boats, making Key West principally a receiving station from which the turtles are forwarded to other markets in this country.

The green turtle inhabits the Atlantic, Indian, and Pacific Oceans, its preference being for the tropical and subtropical parts, although it sometimes strays to the northern part of the Temperate Zone. It is found in greatest abundance about the island of Ascension, the West Indies, and the Atlantic coast of Nicaragua, between latitudes 11° 30′ and 14° 10′ N.

The three external characteristics by which the green turtle may be distinguished from the loggerhead are the front flippers, head, and coloration. The green turtle has but one nail on each of its two front flippers, its head is considerably smaller than that of the loggerhead, and the color of the carapace or back is not uniform but may be a mixture of olive, olive green, and brown, which is usually mottled or streaked with yellow, somewhat resembling that of the hawksbill. Pleasing designs are often found, although the carapace is not used commercially in Key West. The under parts are pale yellowish. The turtle gets its name from the green color of its fat. At the present day the maximum size is 4 feet, with a weight of about 500 pounds, but examples weighing over 300 pounds are seldom taken. In its natural habitat this turtle is herbivorous, feeding on algæ and turtle weed, but in captivity it is said to show a preference for fish.

The egg-laying period is from April to July, at which time the female leaves the water to deposit her eggs on a sandy beach above the high-water mark and in a locality that receives the sun's rays. With her flippers she scoops a hole in the sand, 12 to 18 inches in depth, and after depositing her eggs replaces the sand, instinctively leaving the nest almost undetectable to the eye. This is accomplished by crawling over the freshly filled-in sand and blinding her trail so that the identity of the act is lost. A female is said to deposit about 100 or more eggs in a nest and to repeat this act two or three times during the several months of the egg-laying period. Many turtles are captured after they have come ashore to lay their eggs.

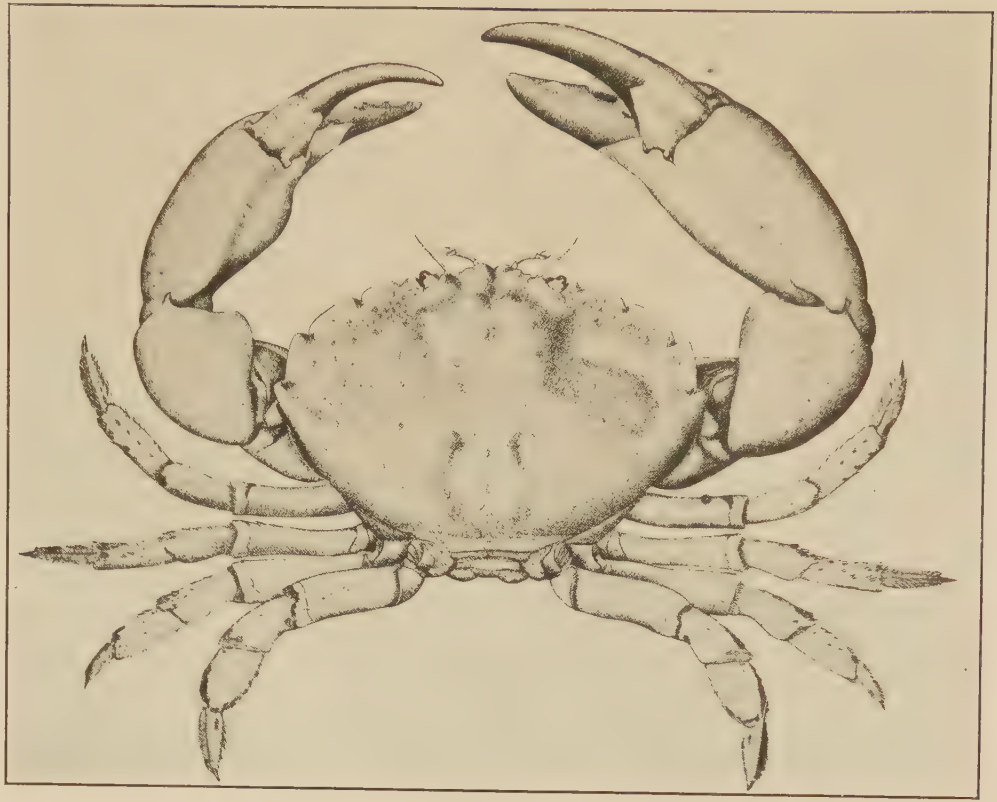

FIG. 23.—Stone crab (*Menippi mercenaria*).

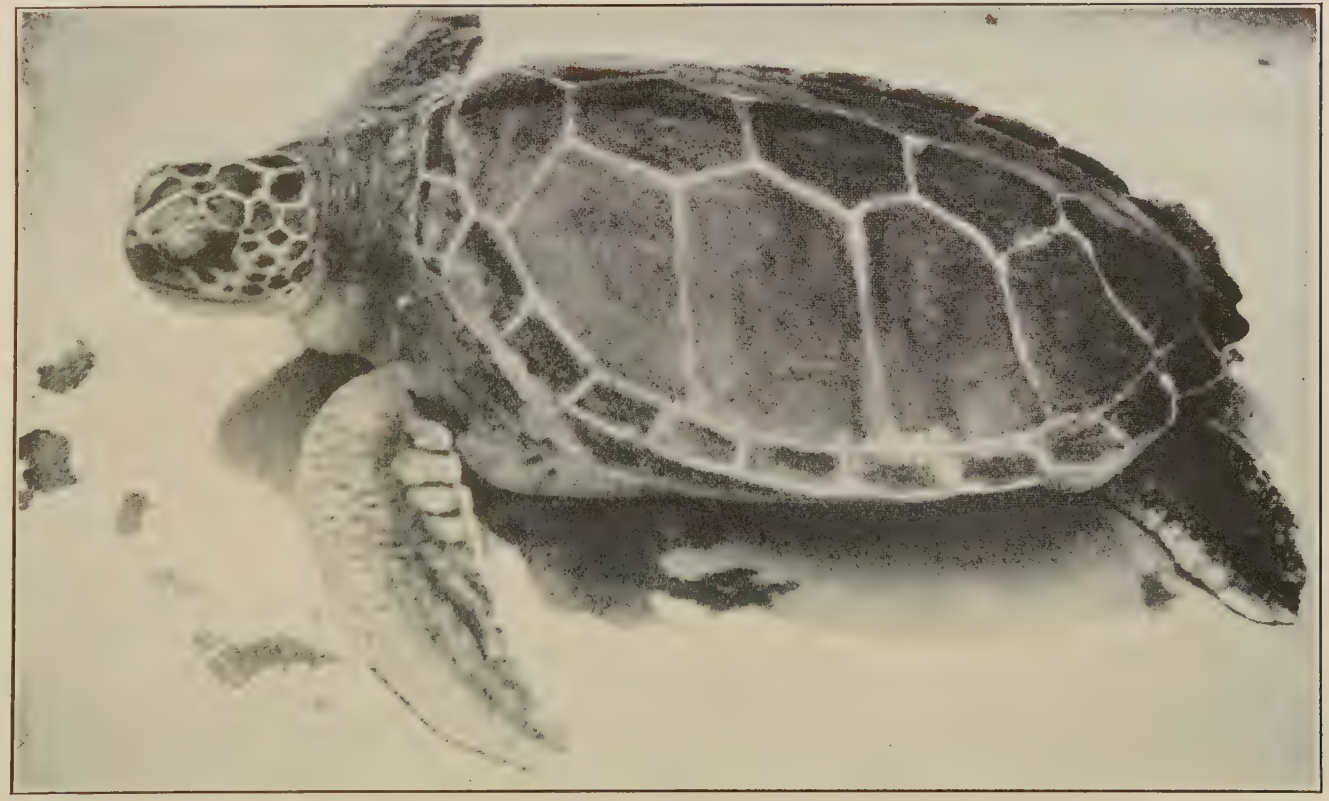

FIG. 24.—Green turtle (*Chelonia mydas*). (Illustration taken from "Reptiles of the World," by R. L. Ditmars. Courtesy of Doubleday, Page & Co.)

FIG. 25.—Loggerhead turtle (*Thalassochelys caretta*). (Illustration taken from "Reptiles of the World," by R. L. Ditmars. Courtesy of Doubleday, Page & Co.)

There is but one dealer in Key West who buys green turtles, and besides making shipments to the north he operates a small soup cannery.

The turtles are landed by fishing schooners known as "turtle boats," most of which fly the British flag. As soon as they are received in Key West the turtles are placed in a turtle crawl. This crawl—the only one in this region—is an inclosure of about 40 by 70 feet, which is surrounded by palmetto logs placed close together in water 15 feet in depth. It is divided into a number of smaller crawls in order that the turtles may be separated into different size groups. In these pens or crawls the turtles will live for a long time, and there is practically no loss to the dealer through mortality. As many as 800 turtles occasionally are held in captivity at one time.

Most of the turtles are landed during the spring and early summer, which is the egg-laying season. During May, 1919, five vessels landed 1,250 green turtles in Key West, each cargo containing from 225 to 300 animals. Many more were received throughout the summer, but by the end of November deliveries practically ceased. Very few turtles are received from December to March, but a good supply is kept on hand in the late fall to last throughout the winter. It is estimated that 170,000 pounds of green turtles were landed in Key West during 1919.

To remove a turtle from the crawl, a loop of manila rope is dropped into the water for the purpose of catching the flipper of a turtle when the animals come to the surface to breathe. When a flipper has been thus caught, the rope is at once made taut and several men haul the turtle up to the dock, where it is turned over on its back to prevent its escape and the rope is removed.

Turtles that are used for canning purposes are slaughtered on the turtle dock. Each day during the greater part of the year five or six are killed at 3.30 p. m., at which time an inspector is present to see that the butchering is done in a sanitary manner. No turtles are killed until the desired number has been removed from the pens and laid about 1 foot apart on the dock. Then one person takes a sharp ax and strikes the head and four flippers off each turtle, going from one to the other with great rapidity. In each case the appendages are almost completely severed, allowing the animals to bleed freely. Immediately after the axman finishes, two men commence cutting away the plastron and then remove the entrails. During the operation sea water is thrown over the carcasses to wash away the blood and slime. The edible portions of the turtle are removed in four large pieces, each of which contains one of the flippers. The flesh is cut away from the carapace and thrown into a barrel of sea water, where it is thoroughly washed. It is then taken to the cannery, where it is hung on hooks and allowed to remain over night for use the next day. The following day a small portion of the meat may be sold for local consumption, but the greater part is used in preparing canned turtle soup.

At least one prominent chef has stated that the carapace is one of the best parts of the green turtle for the making of soup, but the Key West cannery disposes of that part as well as the plastron and entrails by dumping them into the sea some distance from shore.

During May, June, and July the females contain eggs in various stages of development, which greatly enhances their value, as there

is a great demand for the eggs. The white or mature eggs sell for 25 cents a dozen, while the yellow or immature ones bring about 50 cents a pound and are considered a great delicacy. The turtle has two ovaries, and the immature eggs are found in a large cluster in each one. The mature eggs, which are somewhat smaller than a golf ball, are found practically unattached inside the ovaries and have tough parchmentlike shells, which will not break even though the eggs are thrown down with force. A female is said to contain from 6 to 30 pounds of eggs, according to its size and condition.

The smaller turtles are shipped alive to the North, as they command a somewhat higher price per pound than do the larger ones. The following quotations are taken from the New York wholesale market prices of December 29, 1919: Turtles (green) under 100 pounds, 18 cents per pound; 100 to 150 pounds, 17 cents; 150 to 200 pounds, 16 cents; over 200 pounds, 13½ cents. New York, however, obtains only a part of its green turtles from Key West, for many are brought by steamship direct from the West Indies and Central America.

In preparing turtles for shipment on the coastwise steamships the four flippers are pierced and tied together, and the animals are placed back down. This method of shipping turtles has been branded as cruel, but it appears to be a necessity. The piercing of the flippers, however, is not absolutely essential. Because the marine turtles live almost entirely in the water the plastron is developed in such a way that it is not capable of sustaining the weight of the body without injuring the internal organs. Placing a green or a loggerhead turtle in its "natural" position when out of water results in pressure from the plastron against the lungs, causing death from suffocation.

The loggerhead turtle is recorded from all tropical and subtropical seas. The writer has observed one in New York Bay, one off Long Island, and several off the New Jersey coast. Since the loggerhead turtle is of much less commercial value than the green turtle, it has been fished for less aggressively, and for that reason it is probably the more abundant of the two.

The front flippers of the loggerhead are supplied with two nails, except occasionally in old examples, which have but one. The head of the loggerhead turtle is larger than that of the green turtle. The color of the carapace is usually a uniform brown, but sometimes it is faintly marked with yellow. The under parts are yellowish. Loggerheads weighing more than 700 pounds are comparatively rare, the usual size ranging between 40 and 400 pounds. This turtle is mostly carnivorous in its habits, but is said to feed also on a certain grass that fishermen call "turtle weed."

Most of the egg laying takes place during May and June. During the egg laying season one female, according to size and condition, may lay from 50 to 1,000 eggs. The eggs, which hatch in from six to eight weeks, are deposited in the same manner as those of the green turtle. The loggerhead is strictly a marine animal and, like the green turtle, the female forsakes the sea only to lay her eggs.

The loggerhead turtle is fairly plentiful in Florida waters, but it is most abundant on the southwest coast. Compared with the green turtle its value is slight, but it is utilized for food to some

extent in the small fishing villages, and it is not infrequently found in the markets of certain large cities.

Two methods are employed in catching both the green and the loggerhead turtle in the vicinity of Key West—netting and pegging. There are well recognized localities that turtles are known to frequent in search of food, and it is at these places that the turtle fishermen look for them. The senses of smell and taste appear to be well developed, and they will travel long distances in search of their favorite food and feeding grounds.

In netting turtles a large-meshed net is used, and when one or more turtles are discovered in one locality the net is set in a straight line at a favorable place to intercept their progress. As all turtles must rise to the surface for air at more or less frequent intervals they are very liable to be seen in smooth water, and on calm days they can be located several hundred feet away by the sound made when they forcibly exhale air at the surface. While a turtle can not gill itself as fish do, the net nevertheless acts very much in the manner of a gill net. Upon striking the net the turtle usually becomes entangled in the meshes by its head and flippers, and after a futile struggle it rises to the surface where the fishermen are ready to haul it aboard their dory. Some of the turtles, of course, avoid the net, and others that strike it fail to become entangled, but a large percentage of those that strike the meshes are captured.

Pegging turtles is somewhat similar to spearing swordfish. A small sharp barbed spear, to which a line is attached, is fitted loosely on a staff, and upon approaching within a suitable distance of the turtle the spear is plunged into its back. The spearhead usually separates from the staff when it becomes embedded in the back of the turtle, and the animal is held by the line. If the spear is firmly embedded, the capture of the animal in a short time is assured. Fishermen living in isolated places and who desire turtles for food usually employ this method.

In the West Indies and off Central America the greater part of the catch is made during the egg-laying period in the spring, when the turtles are captured on sandy beaches upon which the females have emerged for the purpose of laying their eggs. The marine turtles are poorly equipped for travel on land, and their movements are slow and laborious. For this reason if carefully approached they are easily captured, and by being placed on their backs they are rendered helpless to escape.

The hawksbill turtle is found in the Gulf of Mexico and in the West Indies southward to Brazil. This species is easily recognized by its small size and hard, imbricated shields, of which there are 13 large ones normally surrounded by 24 marginal plates. The carapace shields overlap each other like shingles on a roof, differing in this respect from the green and loggerhead turtles whose shields are smooth. The fore and hind flippers each have two nails, and the horny covers of the jaws form a sharp hooked beak, from which the name "hawksbill" is derived. The carapace of the adult is beautifully mottled with yellow on a dark brown background. The tortoise shell of commerce is obtained from the carapace of this turtle. The shields can be fused by pressure and heat to form pieces of any desired size.

The hawksbill turtle is too scarce about Key West to be considered of much commercial importance. The shells of the few that are caught by local fishermen are kept or sold as novelties. The size of those that are seen ranges from 10 to 15 inches, measured over the longest distance of the back. In Key West these turtles bring from $1.50 to $10 each, according to the size and condition of the plates. The largest specimen of which there is a record measured 34 inches.

SPONGE FISHERY.

Detailed accounts of the Florida sponge fishery have already been published,[4] and therefore the subject will be treated only very briefly in this paper. The old methods of buying, selling, and packing sponges used 30 and 40 years ago are still in vogue, and the fishery of to-day is much the same as it was many years ago. The publication by Dr. H. F. Moore gives an exhaustive account of the sponge fisheries and has been drawn upon liberally in securing data for this chapter.

Florida sponges had a limited domestic use among the inhabitants as far back as the early part of the nineteenth century, or soon after Key West was settled in 1822. It was not until 1849, however, that these sponges became of commercial value. In that year a cargo of sponges was sent to New York on a venture and resulted in the gradual building up of this industry in Florida.

Until 1891 Key West held almost an absolute monopoly of the trade in the United States, but at that time a small sponge mart was established at Tarpon Springs. Because of more advantageous local conditions, the waning of the catch on the Key grounds, and especially because of the development of diving for sponges, Tarpon Springs has become the leading sponge center, relegating Key West to a poor second.

Table 6 shows the extent of the sponge fishery[5] on the Gulf Coast of Florida for the years indicated, from 1895 to 1918. The weights used are taken after the sponges have been cleaned and dried and before they are baled for shipment. The average weights of different grades are as follows: Glove, wire, and yellow, each 1½ pounds per bunch; grass and large wool, 2½ pounds per bunch; small wool, 1 pound per bunch.

TABLE 6.—*Quantity and value of sponges taken on the Gulf coast of Florida in certain years from 1895 to 1918.*

Kinds of sponges.	1895		1897		1900		1902		1918	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Sheepswool	231,272	$363,107	157,476	$240,599	181,311	$483,263	133,518	$297,727	276,168	$675,781
Yellow	29,509	11,798	32,362	13,082	74,466	44,045	56,787	31,113	91,641	34,187
Grass	21,387	5,464	128,622	29,188	143,112	33,263	140,682	29,765	73,033	12,125
Others	23,952	6,502	13,086	3,171	19,236	7,114	15,902	5,817	11,346	3,062
Total	306,120	386,871	331,546	286,010	418,125	567,685	346,889	364,422	452,188	725,155

[4] Commercial Sponges and the Sponge Fisheries. By H. F. Moore. Bulletin, U. S. Bureau of Fisheries, Vol. XXVIII. 1908 (1910), Part I. B. F. Doc. No. 667.

[5] Fishery Industries of the United States. Report of the Division of Statistics and Methods of the Fisheries for 1919. By Lewis Radcliffe. Appendix X, Report, U. S. Commissioner of Fisheries for 1919 (1921), pp. 160–161. B. F. Doc. No. 892.

TABLE 7.—*Relative importance of Key West and Tarpon Springs as sponge centers from 1888 to 1918.*

Locality.	1888		1895		1897		1900		1902		1918	
	Number of pounds landed.	Per cent of total catch.	Number of pounds landed.	Per cent of total catch.	Number of pounds landed.	Per cent of total catch.	Number of pounds landed.	Per cent of total catch.	Number of pounds landed.	Per cent of total catch.	Number of pounds landed.	Per cent of total catch.
Key West	238,038	94	280,372	92	270,906	82	359,854	86	266,841	77	107,743	24
Tarpon Springs	.....	.....	16,344	5	56,000	16	53,173	13	67,218	19	344,445	76
Others...	15,652	6	9,404	3	4,640	2	5,098	1	12,830	4	.....	.....

In 1919 the quantity of sponges sold at the Tarpon Springs exchange amounted to 424,075 pounds, valued at $707,964, and in 1920 the quantity sold was 409,746 pounds, valued at $678,209. The catch at Key West for these years is not available, but it is probable that it did not exceed 125,000 pounds for either year.

In 1921 the quantity of sponges sold at the sponge exchange, Tarpon Springs, Fla., was 386,390 pounds, valued at $540,093, of which 173,723 pounds, valued at $463,170 were large wool; 63,786 pounds, valued at $28,705, small wool; 70,218 pounds, valued at $30,428, yellow; 65,745 pounds, valued at $12,623, grass; and 12,918 pounds, valued at $5,167, wire. The prices of the small wool sponges were so low in the latter part of 1920 that several thousand bunches were held over for sale in 1921. For this reason the 1921 totals were larger than for the preceding year. It is estimated that sponges amounting in value to $40,000 were sold outside of the exchange at Tarpon Springs.[6]

In 1922 the quantity of sponges sold at the sponge exchange, Tarpon Springs, Fla., was 526,885 pounds, valued at $699,092, of which 248,475 pounds, valued at $596,199 were large wool; 70,478 pounds, valued at $42,286, small wool; 115,455 pounds, valued at $37,637, yellow; 84,892 pounds, valued at $20,379, grass; and 7,585 pounds, valued at $2,588, wire. It is estimated that sponges to the value of $50,000 were sold outside of the exchange at Tarpon Springs.[7]

The principal kinds of sponges brought into Key West, in the order of their importance, are the sheepswool, yellow, and grass. These are divided into numerous subvarieties and grades. Glove sponges, although generally common throughout the Florida keys, have but a small commercial value and are sold only in limited quantities. Other kinds, such as velvet and wire sponges, are of minor importance in the Key West market.

"The sponging grounds as at present developed are broadly divided into two widely separated areas—the 'bay grounds,' lying in the open waters of the Gulf of Mexico from about Johns Pass to St. Marks, and the 'key grounds,' stretching along and among the reefs and keys from Cape Florida to Boca Grande Key." (Moore, 1908.) Doctor Moore states further that "the grounds as exploited and

[6] Fishery Industries of the United States. Report of the Division of Fishery Industries for 1921. By Lewis Radcliffe. Appendix IX, Report, U. S. Commissioner of Fisheries for 1922 (1923), p. 70. B. F. Doc. No. 932.

[7] Fishery Industries of the United States. Report of the Division of Fishery Industries for 1922. By Harden F. Taylor. Appendix V, Report, U. S. Commissioner of Fisheries for 1923, p. 63. B. F. Doc. No. 954.

worked by the hookers up to the time of the introduction of diving apparatus, in April, 1905, covered an area of 4,350 square miles, of which the bay grounds contained about 3,400 and the key grounds about 950 square miles. It must not be considered, however, that all of this area is productive, for, on the contrary, the actual sponge-producing bottom in any given field is far less than the barren areas with which it is mingled." Since the introduction of diving a considerable area has been added to the sponge grounds, because operations can be carried on at greater depths.

In Florida two methods are used in gathering sponges—diving and hooking. A sponge-diver's outfit generally consists of a schooner of between 10 and 20 tons register and one or two machine boats. The schooner is used as living quarters for the crew and a place of deposit for the sponges. The machine boats carry the usual diving apparatus and are of the Greek type, with high bows and sterns. The diving dress consists of a helmet, rubber suit, breastplate, shoes, and weights. Generally seven to nine men are carried, consisting of a captain, deckhand, cook, and a diving crew. The great majority of divers' boats operate from Tarpon Springs.

The divers generally operate at a depth of 60 feet or less and remain down for about two hours at a time. As there are two divers to a boat, each man works about two hours and rests for a like period. At greater depths the working time is shorter and the rests longer. The sponges are gathered by hand and placed in a net basket, which is pulled to the surface from time to time to be emptied. The divers often work in places that are inaccessible to the "hookers," and it is probable that the sponges found in such localities could not be obtained by any other method. The daily catch varies considerably, but it usually averages from 10 to 15 bunches for each boat. Occasionally a prolific bed is found, resulting in a catch of 40 or 50 bunches in one day. The boats often remain away for one to two months, but sometimes a good catch is made in one week.

The Key West fishermen use the sponge hook almost exclusively. Prior to 1905 all sponges in this country were taken with hooks, but diving has proven so much superior that the old method is now of small importance in the fishery.

The sponge hook has the one advantage that it can be used by one or two men and at practically no expense. The hook is attached to a pole of convenient length and has three tines bent at right angles to the handle, so that a sponge may be lifted perpendicularly from the bottom. The typical hook fisherman has a sloop 25 to 40 feet long on which he lives and a 12 or 14 foot dory in which he works. Sails are generally depended upon in going to and from the grounds, as only a few of the boats used are equipped with auxiliary engines.

The hook fisherman usually operates among the keys where the water is clear and about 6 to 15 feet in depth. Except when the water is very smooth a sponge glass (that is, a wooden bucket with a glass bottom) is used for locating the sponges. When two men work together, the hooker remains in the bow with the sponge glass and directs his companion in the movements of the boat. Sometimes one man works independently, in which case he weights the stern of the dory with iron and propels the boat by pushing on the bottom

with his sponge hook. It is seldom that a fisherman working alone is able to use the sponge glass.

A few larger boats of the small schooner type engage in hooking. Two or three dories are carried, each of which is manned by two men. Fishing is done in water ranging from 12 to 30 feet in depth, necessitating long poles that are difficult to handle.

When removing sponges from the bottom care must be taken not to mutilate them. Sometimes they are firmly attached, and the sponge hook either fails to dislodge them or tears them in such a way that their value is materially reduced. The diver, since he gathers them by hand, is able to take most of his sponges in perfect condition.

The sponge as an article of commerce is merely the skeleton of the living animal and is of very different appearance than when first removed from the water. When first taken, it is a comparatively heavy mass of living matter, most of the porousness of the market sponge being filled with live animal tissue. The color of live commercial sponges is usually dark brown or black.

After the sponges have been taken aboard the deposit boat they are laid on deck, where they undergo a three or four day exposure to the air to kill all of the living tissue. In this state decomposition sets in and some of the liquid organic matter drains away. It is advantageous to shade the sponges, or the sun will quickly dry the outside skin and render the subsequent cleaning more difficult. After sufficient exposure the sponges are beaten with a short heavy club to loosen the remaining skin, dead tissue, and foreign matter. They are then strung on strong cord and thrown overboard, where they are allowed to remain for several days to macerate by the action of the tide. Another method of cleansing sponges by tide action is to place them in crawls. Crawls are small inclosures made with stakes set closely together in shallow water generally very near to shore. "Usually on Friday night the vessels run in to the crawls, and Saturday is spent in 'crawling' the dead sponges of the recent catch and cleaning those deposited on the Saturday previous." (Moore.)

With a dull knife the remaining particles of the outside skin are scraped off, and with a stout club the small pieces of shell, coral, and other matter, together with the remaining dead tissue, are pounded out of the skeleton. Finally, water is taken up and squeezed through them a number of times, and after being strung in bunches they are ready for the auction market.

Sheepswool sponges caught on the Key grounds are usually small in size and of weak fiber as compared to those taken in the deeper water of the bay grounds. Inferior sponges can be distinguished readily by the red-brown color of the inner fiber. In some sponges this reddening is found only at the root, but in the most inferior it penetrates well into the body. The best quality sponges are of a grayish hue throughout, although some may show a reddish spot at the point of attachment to the ocean bed. The color itself is one of the least important factors in determining the value of a sponge, however. A fine sponge is determined by the following characteristics: Size and shape, softness, fineness, toughness and durability, resiliency, and absorptiveness.

The fishermen sell their catch by the bunch—a piece of cord 4⅝ feet in length being strung with sponges placed end to end. As far as

practicable, sponges of the same grade and size are bunched together. In order to display them to the best advantage they are dampened and laid out on the sponge wharf, where they may be critically examined by the buyers.

The method of selling is rather unique. The auction is carried on in comparative silence, as the buyers are men of experience and require no advice as to the value of the various lots of sponges. The hour before the sale is spent by the buyers in examining the merchandise and making note of the highest price they will pay per bunch for each of the various lots. During the sale the auctioneer announces the number of bunches in the lot being offered and receives the offer of each bidder written on a small piece of folded paper. The highest bidder is awarded the sponges without argument, providing the owner considers the amount sufficient. No more ceremony enters into a $5,000 sale than in one of $5. The prices paid for any one variety of sponge may vary considerably according to quality and size. Selecting the extremes, the wide variation of prices is illustrated from the following data collected at Key West on January 21, 1920, during the morning's auction sale:

Sheepswool sponges: One lot of 200 bunches, $1,427; one lot of 226 bunches, $1,587; one lot of 17 bunches, $12; one lot of 5 bunches, $4. The best quality brought $7.13½ a bunch for a lot of 200 bunches, while the most inferior brought only 70 cents a bunch for a lot of 17 bunches. A feature of the sale, aside from the several lots of fine wool sponges, was the disposal of 9 very large wool sponges for $48, or $5.33 a sponge. These sponges were truly as "large as a bushel basket" and are now quite rare in the market. The highest price paid for yellow sponges was 96 cents a bunch for a lot of 49, and the lowest price was 56 cents a bunch for a lot of 48 bunches. The only lot of grass sponges (5 bunches) sold at 48 cents a bunch.

After the dealers purchase the sponges they prepare them for the market by trimming and shaping and by removing the remaining foreign matter which the fishermen did not succeed in beating out. The sponges are packed in burlap bales of 15, 30, 50, or 60 pounds net weight, and in each bale is placed but one variety and as a rule but one grade. Sponges that have large crab or coral holes and that are badly torn or otherwise imperfect are cut into smaller shapes known as "cuts." Those that have imperfections but do not require cutting are termed "seconds," while the whole perfect specimens are known as "forms."

The production of sponges on the Florida beds has not kept pace with the great demand, and the result is that the shallower grounds have been greatly depleted and in places completely devastated. This has necessitated fishing in deeper and deeper water and has forced many of the fishermen to resort to different occupations. This condition shows clearly that sponges should be allowed to propagate under natural conditions, and that they should be fully protected by law.

In 1917 the State of Florida enacted a law requiring that the minimum size of commercial sponges taken from State waters should be not less than 5 inches in horizontal diameter. A few years prior to that time the United States Government had enacted a similar law with regard to sponges taken from waters under its jurisdiction. This law if rigidly enforced should prove beneficial to the sponge

industry. The law of Florida prohibits sponge divers from operating in State waters. However, most of the divers' boats fish not closer than 9 miles from shore.

Sponges have been grown by artificial culture[8] but comparatively little has been done in this direction during the past 10 years.

FLORIDA CONCH.

The conch of Key West (*Strombus gigas*) is a large gastropod that is used to a limited extent as food. It is found in shallow water near the shores of the keys and is easily captured with a sponge hook or by hand. It is also found in the Bahamas and the West Indies. It sometimes attains a length of 1 foot and a weight of 5 pounds. The animal itself, which averages about 1 pound in weight, is incased by a large thick shell. Very often the inner lining of the shell is beautifully tinted with pink, and choice specimens are sold in local novelty shops for 25 or 50 cents each. When sold as food, the flesh of the animal is removed from the shell and for convenience in handling is strung on a small stick. It is peddled about the city at about 5 cents for each conch. During 1918 about 2,000 pounds, worth $100, were sold in Key West.

The conch requires several hours' cooking to render it palatable. One person in the city prepares a chowder in concentrated form, which is preserved in glass jars or friction-top cans. In this form small quantities of the preparation are sold by mail. In the West Indies and the Bahamas the most desirable parts of the conch shell are exported to Europe, where they are utilized by cameo cutters. Conchs are plentiful enough to supply the present demand, but the supply could easily be depleted by overfishing.

CLAM INDUSTRY OF SOUTHERN FLORIDA.

What is probably the largest bed of hard clams in the United States is to be found off the southwest coast of Florida, in the region of the Ten Thousand Islands. The bed is about 40 miles long and 5 miles wide and is estimated to contain an area of nearly 150 square miles that produces clams. The southern part of this bed is about 70 miles from Key West and can be reached in less than 24 hours with a small sailboat.

The hard clam is of minor importance in the Key West fisheries but of considerable importance on the southwest coast of Florida. The small catch landed in Key West is due to the lack of demand by the local population rather than to the distance of the clam beds from the city.

Since 1889, at least, Key West boats have made occasional trips for clams during the spring, summer, and fall. The journey is seldom made during the winter because more profit can be made at that time in catching kingfish and spiny lobsters. From 1889 to 1915 the annual catch landed in Key West varied from 10,000 to 25,000 clams. During 1918 eleven trips were made by two fishermen, who operated the only boat engaged in this business. The total catch for the year amounted to 38,000 clams.

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[8] A Practical Method of Sponge Culture. By H. F. Moore. Bulletin, U. S. Bureau of Fisheries, Vol. XXVIII, 1908 (1910). B. F. Doc. No. 669.

The Florida hard clam (*Venus mercenaria mortoni*) bears a close resemblance to the New England quahaug (*V. mercenaria*). It is difficult to separate the two varieties when comparing specimens 3 or 3½ inches in length, but in general the southern clam attains a larger size and has a thicker and heavier shell. It is not unusual to find these clams weighing more than 2 pounds each. About 125 clams of average size fill a 5-peck basket, and as a full basket weighs about 125 pounds the average weight of a clam is 1 pound.

The clams may be divided into three types, although they all belong to one species. There is a thick-lipped type, a thin-lipped type, and an intermediate type. The thick-lipped clams are sometimes known as "bullnose," and are said to be somewhat inferior to the thinner-lipped variety. The shell of the thin-lipped clam is somewhat lighter than that of the "bullnose," but it is heavier than the shell of the northern quahaug. It is probable that the thickness of the shell at the lips is due to some extent to age and retarded growth, but the fact remains that small thick-lipped clams may be found in places where the clams are scattered, and large thin-lipped ones are found where clams of all three types are exceedingly abundant. The relative abundance of each type, judged by the averages obtained from numerous examinations made in various parts of the great clam bed, is as follows: Thick-lipped, 50 per cent; thin-lipped, 30 per cent; and intermediate, 20 per cent. The average size of 50 thick-lipped and 50 thin-lipped clams selected at random was 3½ inches for the former and 3⅜ inches for the latter variety. Measurements were taken with calipers, the points of which touched the hinge ligament and the farthest opposite point. Measured in this way about 95 per cent of the clams, whether dug by hand pickers or dredge, ranged between 2½ and 5 inches in length.

Dead clamshells are found almost everywhere on the clam beds. In some places they are very abundant, while in others they are occasional. It is said that the clam dredge kills many of the clams, but this is improbable for the following reasons: (*a*) The dead shells are found over almost the entire bar; (*b*) the dredge has worked over but a small portion of the clam bar and only in two or three restricted localities; (*c*) nearly all the shells are unbroken, while many of them would likely be mutilated had the dredge been responsible; (*d*) the writer dug several hundred clams in a locality where the dredge certainly never had operated and found many dead shells; and (*e*) sometimes a single valve was lying flat on the bottom and sometimes the two valves were intact and filled with mud but were buried in the same position as when living.

It is but natural that many clams should die where their numbers are vast and when they live in a region almost untouched by man. Like all living things, clams must die at some time of old age, if for no other reason, and this may be responsible for the presence of many dead shells. Sudden changes in the salinity of the water may also cause a part of the mortality. Fresh water supplied by the numerous small rivers of the Ten Thousand Islands lowers the density of the water on the clam bar, particularly during the rainy season. This brackish condition of the water is especially suitable for the growth of the clams. During the winter, however, when rains are very infrequent, the density of the water increases until it is equal to that of Key West or other points not affected by fresh water.

FIG. 26.—Hook fisherman searching for sponges, aided by a water glass.

FIG. 27.—Sponge yard at Key West, showing the sponges drying

FIG. 28.—This dredge was used for digging clams along the coast of the Ten Thousand Islands, Fla., and until September, 1922, when a second dredge was put in operation, it was the only one of its kind in existence. As pictured, the dredge was stationed at Marco for repairs.

FIG. 29.—The dock of the Marco clam cannery and freight boat ready to leave for Key West with a cargo of canned clam products. At Key West the cases of clams are placed aboard a coastwise steamship for delivery in New York.

It is believed that long periods of high salinity have a deleterious effect on the clams.

Clams are found in varying abundance from Gullivan's Bay to Shark Point. The bed gradually widens from Coon Key to Pavilion Key, and thence continues to Porpoise Point, after which it narrows until Shark Point is reached. Below Shark Point the bottom is mostly of firm sand and is unsuitable for the growth of clams.

The clams are very plentiful over a large part of the bed, and no difficulty is encountered in finding a suitable locality for digging. The areas of greatest abundance occur immediately north to northwest of Pavilion Key, between Seminole and Porpoise Points and directly off Clam Point. There are places where few or no clams are found, and as a rule none are present within a few hundred feet of shore.

The following data will illustrate the general abundance of clams in the areas designated. The terms used can be interpreted as follows: "Scattered," where not more than five clams per square yard are present. "Fairly abundant," "abundant," and "very abundant," where from more than five to many clams per square yard are present.

Coon Key.—Two and one-eighth miles southwest of Pyramid Light; depth, 4 feet, mean low water. Clams abundant. One mile WSW. of Pyramid Light; depth, 4½ feet. Bottom of rather firm gray mud with scattering shell. No clams found. One-half mile SSE. of Pyramid Light; depth, 5 feet. Bottom of sticky mud with much eelgrass. Clams very abundant. One-third mile S. by E. of Coon Key, within a few hundred feet of Pyramid Light; depth, 4 feet. Bottom of mud and eelgrass. Clams abundant. One and one-fourth miles southeast of Pyramid Light; depth, 6 feet. Bottom of shell and hard mud; eelgrass. Clams fairly abundant. One and one-half miles southeast of Pyramid Light; depth, 7 feet. Bottom of mud and shell; eelgrass. Clams fairly abundant. Two miles southeast of Pyramid Light; depth, 7 feet. Bottom soft; broken shell. Clams scattered.

Horse Key.—One mile S. by W. ½ W. of Horse Key; depth, 7 feet. Bottom of rather hard mud and broken shell. Clams scattered. One mile W. ½ N. of outer shore of Horse Key. Bottom hard; eelgrass. Clams fairly abundant. Directly inshore from the last-mentioned locality and 600 feet from the shore of an unnamed island. Bottom hard mud and shell. No clams. One-half mile W. by N. of Horse Key; depth, 6 feet. Bottom soft mud; eelgrass. Clams scattered. Off Horse Key, close to shore; a reef of coon oysters surrounds this key and is exposed at low tide. Tests for clams were made several hundred feet beyond the reef, but none were found.

Panther Key.—One mile SSW. of Panther Key; depth, 7 feet. Bottom hard mud. Clams widely scattered. One-half mile SSW. of Panther Key; depth, 6 feet. Bottom rather hard; eelgrass. Clams fairly abundant.

Round Key.—Close to the shore of Round Key very few clams were found. Offshore 1 mile clams were abundant.

Tiger Key.—Three-eighths of a mile WSW. of the southeast end of Tiger Key; depth, 5 feet. Bottom hard mud. No clams. One-half mile S. by W. ¾ W. of the southeast end of Tiger Key; depth, 7 feet. Bottom rather hard mud. Clams fairly abundant.

Indian Key.—One and one-fourth miles SE. by E. ½ E. of Indian Key; depth, 6 feet. Bottom hard mud. No clams.

Chokoloskee Pass.—One mile WNW. of mouth of pass; depth, 4 feet. Bottom hard. No clams. Mouth of pass; depth, 1½ to 5 feet. Places were found with hard bottom and without eelgrass where no clams were located. Other places where the bottom was somewhat softer and on which eelgrass was growing contained an abundance of clams.

Rabbit Key.—One and one-fourth miles NW. by W. of Rabbit Key; depth, 6 feet. Bottom hard with light stratum of silt; eelgrass sparse. Clams fairly abundant. One-fourth mile NW. by N. of Rabbit Key; depth, 5 feet. Bottom hard. Clams scattered. One-eighth mile SW. by W. of north end of Rabbit Key; depth, 5 feet. Bottom hard mud and broken shell; eelgrass. Clams abundant.

Pavilion Key.—Two miles northwest of Pavilion Key; depth, 4½ feet. Bottom varies from hard to rather soft mud; eelgrass. Clams abundant. One and one-half miles NW. by N. of Pavilion Key lies a bar 1 mile long and one-half mile wide which contains clams in great abundance. The depth of water varies from 1 to 3 feet, mean ebb tide, and clams can be dug by hand during low tide. The bottom is of sticky mud and eelgrass, which easily bears the weight of a person. One mile N. ½ W. of the north end of Pavilion Key. In this general locality the clam dredge has been working for several years. Although thousands of bushels of clams have been dug, they appear to be abundant still. One-half mile west of the center of Pavilion Key; depth, 5 feet. Bottom hard. No clams. One and one-half miles southeast of Pavilion Key; depth, 5 feet. Bottom hard with light stratum of silt. Clams very scattered. Two miles southeast of Pavilion Key; depth, 7 feet. Bottom hard, with stratum of silt. Clams fairly abundant. Two and one-half miles southeast of Pavilion Key; depth, 7 feet. Bottom rather hard with stratum of silt; eelgrass. Clams abundant.

Clam Point.—One mile WSW. of Clam Point; depth, 6 feet. Bottom rather hard with stratum of silt; eelgrass. Clams abundant. In and about the shore of Clam Point clams are very abundant. The bottom is of sticky mud and eelgrass. At low tide parts of the bar are almost uncovered and the clams can easily be dug by hand. Here the writer obtained 200 clams in 1 hour with but little effort.

Turkey Key.—One-half mile WNW. of Turkey Key; depth, 5 feet. Bottom sticky mud; eelgrass. Clams abundant.

Seminole Point.—One-half mile southwest of Seminole Point; depth, 5½ feet. Bottom of firm mud; eelgrass. Clams abundant.

Alligator Point to Porpoise Point.—Clams are very abundant nearly everywhere in this territory. An extremely prolific bar lies about three-fourths of a mile off Alligator Point, and it is here that the Key West boats obtain their clams. A white house, one of the few landmarks to be seen on the long stretch of coast adjoining the clam bar, is located on Porpoise Point, locally known as Wood Key.

Lossmans River.—One mile SW. ½ W. of the mouth of Lossmans River; depth, 2 feet. Bottom of mud, broken shell, and eelgrass. Clams fairly abundant. One and one-half and 2 miles southwest

of the mouth of Lossmans River; depth, 3 to 7 feet. Bottom rather hard mud; small broken shells. Clams widely scattered. Dead clamshells were very plentiful.

Highland Point.—One and one-fourth miles southwest of Highland Point; depth, 6 feet. Bottom sticky mud; eelgrass. Clams abundant.

Rodgers River.—One and one-half miles west of Rodgers River; depth, 4½ feet. Bottom sandy mud. Clams abundant. Two miles southwest of Rodgers River; depth, 5 feet. Bottom sandy mud. Clams fairly abundant.

Shark Point.—One mile W. by N. of Shark Point; depth, 5½ feet. Bottom sticky mud. Clams scattered. Two and one-fourth miles SSW. of Shark Point; depth, 5 feet. Bottom hard sand. No clams.

Along the coast of the Ten Thousand Islands the shore slopes very gradually into the Gulf. At 1 mile offshore the depth varies from 4 to 7 feet at mean low tide, and from there to the 5-mile line the slope is about 2 feet per mile. Because of this small depth of water the clams can readily be taken over the entire bar. The offshore part of the bed, however, has never been worked, for clams are to be found in great abundance near shore where the water is very shallow and protection is afforded from the sea.

The bottom of most of the clam bed is of rather firm gray mud, on top of which is a stratum of silt several inches in depth. Eelgrass thrives in nearly all places where clams are abundant. In most places where this grass is absent few or no clams are present.

Two methods are used in procuring the clams—hand digging and dredging. No tongs are used in this region, for the clams are too abundant and accessible to require such apparatus. Furthermore, the consistency of the soil, which is a sticky mud, would render tonging difficult.

Digging clams by hand was the sole method used before the advent of the dredge. After the dredge came into use hand digging was resorted to from time to time only when the dredge became temporarily disabled. From 1919 to 1922 considerable hand digging was done owing to frequent breakdowns of the dredge and its inability to supply the two canneries with sufficient clams. During this time from 10 to 15 diggers were employed. They received 40 cents for a 5-peck basket of clams and could dig, according to the individual, from 10 to 20 such basketsful a day.

Hand digging can be done at all times except, perhaps, when the tide is at its highest point. The diggers keep pace with the tides, working away from shore during the ebb and toward the shore during the flood. To work with any degree of comfort, the maximum depth of the water should not be much greater than an arm's length.

The clams are located by wading about in the water, for which reason this method is sometimes called "treading clams." The clams are so plentiful that a digger can work within a small area for days at a time. When a clam is located with the foot it is removed from the mud with a 2-tined fork having a 6-inch handle. Each hand digger is equipped with a small flat-bottom boat, in which the clams are deposited after they are dug. The boat is

pushed along with one hand and affords a means of balance while the operator stoops over to disembed the clams. When a boat becomes loaded, it is poled or pushed to shore, where the clams are cached in shallow water to await the arrival of a "run boat," which brings them to the canneries. During the course of a day a hand digger makes several trips to shore with clams.

Dredging is by far the most efficient method of procuring clams. The dredge used in the Key West region is of a unique type, one that is not used in any other part of the world. The first dredge was operated about 1905, but some years afterwards it was destroyed by fire. Later a new dredge was built and was still in use at the time of this writing. In September, 1922, a second dredge was put in operation to supply the increasing demands of the canneries. After the second dredge began working hand digging ceased entirely, for the two dredges have been able to dig sufficient clams to supply all demands. The new dredge has not been observed by the author, but it is understood that aside from a few improvements it was built on the same general plan as the old one, a description of which follows.

In general appearance the dredge resembles a houseboat. It is about 90 feet long and 20 feet wide and has two stories. Dividing it into thirds, the digger is situated in the middle, the machinery and tool room on one end and storage space for the clams on the other end. The second story is devoted to sleeping quarters and mess room.

The machinery is gasoline driven, a 36-horsepower engine being used, and heavy chain belts drive the various wheels and gears. The digger itself is a rather powerful machine. It has 10 rows of teeth, each row being separated by a distance of about 2 feet. The teeth are detachable in series of two and are attached by bolts to heavy strap iron, 18 teeth forming a complete row. The ends of the strap iron are attached to the chain belt, which revolves the digger. Each tooth when new is 6 inches long and curved, and a complete series of 18 digs an area about 6 feet in width.

The digging apparatus, which resembles a thick rectangular figure rounded on each end where the cogwheels are located, is set at an angle, allowing one row of teeth to dig at a time. The position of the digger is regulated to the depth of water by two heavy counterweights, which are placed at the extreme end of the dredge. The clams, soil, etc., are carried up by the curved teeth, and on the downward turn they are deposited on a moving wooden escalator or conveyor, which is provided with raised strips of wood at convenient intervals to prevent the clams from rolling back into the water. This escalator is an unique appliance—it might better be called a wooden belt conveyor. That part of the conveyor upon which the clams are deposited is under water, so that when the clams reach the pickers they are partially cleansed of mud.

At the top of the wooden conveyor two or more men pick the live clams, which are thrown into baskets. One man is employed to remove the filled baskets and to replace them with empty ones, as the pickers can not move from their positions without missing some clams, which would be carried over and into the water by the conveyor on its downward turn. When three baskets have been

filled they are placed on a small car and rolled to the end of the dredge, where they are piled up until transferred to the run boat.

From two to four men are required to pick the clams from the conveyor, which moves at a speed of about 1 foot per second. At times a moment will pass when there are no clams, but suddenly a dozen or more will appear in a cluster. The pickers are generally kept continuously busy, and they are very skilled in picking out the live clams from the masses of débris and dead shells. The fact that all undesired material is automatically cast back into the water, without the slightest physical effort, is one of the principles that made this type of dredge a success. A full crew consists of a captain, engineer, cook, rope man, four clam pickers, and one man to care for the baskets as they are filled.

The dredge moves slowly while digging, traveling 1,200 feet in about one and one-half hours. This slow movement is accomplished by drawing in on a 1,200-foot cable attached to an 800-pound anchor. The distance traveled when the full length of the cable has been drawn aboard and the dredge reaches the anchor is termed a "run." With the anchor as a center each run of the dredge compares with the radius of a circle. Upon the completion of a run the cable is released and the dredge drifts back with the wind and the tide, and because of their variation the dredge never digs over the same course twice except possibly near the anchor where all the radii meet. Because of the great abundance of clams it is said that the dredge has been able to dig in one locality for several months at a time without shifting its anchor.

It has been claimed that large mounds of mud are left on both sides of the strip of bottom that is being dug over, but from the mechanism and operation of the machine this would seem very improbable, as the soil is not dumped to one side or the other but is merely worked over and deposited again more or less uniformly. The teeth of the dredge dig an area about 5 inches deep and nearly 6 feet wide. As the teeth strike the bottom, part of the muddy soil passes through the interspaces, while whatever mud adheres to the teeth is partly washed away before it reaches the wooden belt conveyor. The conveyor casts the residue back into the water, breaking it up still further before it reaches the bottom, and much of the mud settles back evenly on the bottom from which it was taken. For this reason it is not believed that clams or other animals are smothered by becoming buried beneath a heavy layer of soil and débris.

The majority of the clams dug by the dredge are from 2½ to 5 inches in size, measured from the hinge ligament to the farthest opposite point. Very few small clams are dug, but it is possible that they pass between the teeth of the dredge or are otherwise lost before reaching the wooden conveyor. About 3 per cent of the clams are broken by the digger, and are discarded as they would be decomposed by the time they reach the canneries.

The dredge digs from 80 to 120 five-peck baskets of clams on one run, and from 350 to 450 baskets during a day. As there are now (1923) two dredges in operation, this quantity of clams is utilized by each of the two canneries every working day. During 1922 the one dredge in operation worked about 300 days, digging continuously throughout the year except during part of August and September, which is known as the "gale season."

During 1918 the dredge dug about 28,000 baskets of clams (35,000 bushels). In 1919 it dug 34,439 baskets (43,049 bushels) and hand pickers dug 4,000 baskets (5,000 bushels), making a total of 48,049 bushels for this region. In 1922 one dredge dug 112,500 baskets (140,625 bushels); the new dredge dug about 22,000 baskets (27,500 bushels) during October, November, and December, and hand pickers secured about 30,000 baskets (37,500 bushels) during the year. This total of 205,625 bushels is by far the greatest number of clams ever taken from the waters of Florida in one year.

With the exception of the few brought to Key West, all the clams dug in this region are utilized by two canneries, one of which is located at Marco and the other at Caxambas, Lee County. The Marco cannery has an annual capacity of 100,000 cases of clam preparations, but the Caxambas factory is somewhat smaller. The Marco factory canned to its full capacity during 1922 and has continued to pack 2,000 cases a week up until the time of this writing (August, 1923). The following preparations are canned:

"*Little-neck*" *clams.*—These clams are not as small as the little-neck variety of the North but they usually measure less than 3¼ inches from hinge ligament to the farthest opposite point. They are packed in No. 1 cans, 2 and 4 dozens to the case, and in No. 2 cans, 2 dozens to the case.

"*Steamed*" *clams.*—These are the larger clams, measuring 3¼ inches or more, and they are packed in No. 1 and 2 cans, 2 dozens to the case.

Minced clams.—These are the larger clams that have been chopped up for use in preparing chowder, soups, fritters, etc. Minced clams are packed like "little necks."

Clam chowder.—Minced clams enter into the preparation of clam chowder. Most of the vegetables used in making the chowder are obtained from New York via Key West. Even the potatoes used are shipped from the North, as it is said that the Florida potatoes fall to pieces and do not hold their shape when diced and cooked.

Clam juice, plain.—This is the pure liquor of the clam, and it is packed in No. 1 cans, 2 and 4 dozens to the case, and in No. 2 cans, 2 dozens to the case. It is also packed in glass bottles, 1 dozen to the case.

Clam juice, concentrated.—Packed the same as clam juice plain.

The Marco clam cannery commenced operation in 1909, but was replaced by a more modern structure in 1919. The new building is constructed of corrugated galvanized iron with a cement floor. Within the building has been built a large concrete cistern to hold rainwater, which is obtained from the broad expanse of the roof. Thus far attempts to locate an adequate and dependable supply of good fresh water have met with failure. Considerable water is needed to prepare the various clam products, making the conservation of the supply furnished by the heavy rains during the summer of great importance for the successful operation of the cannery.

The cannery has been equipped with the most modern and efficient machinery peculiar to its needs. The general routing of operations embraces a good example of straight-line production, as the raw material is received at one dock and in the course of preparation passes through the building in an undeviating line and is delivered at another dock in the form of the finished product, packed

and ready for shipment. The various methods of procedure will be briefly described.

When the clams are received aboard the run boat from the dredge they are deposited in a heap on deck, and the baskets are retained by the dredge. The run boat generally starts on the homeward journey about midnight, arriving in the vicinity of Marco about daybreak, and delivery is made early in the morning. A reserve supply of clams is rarely kept on hand, and the cannery, therefore, depends upon a fresh supply from day to day.

The population of Marco in 1919 was about 150 persons, and aside from a small amount of fishing and hunting the cannery furnished the only means of support to the inhabitants. Because of weather conditions and an occasional breakdown of the dredge it is never certain on which days work will be available, and for this reason as soon as a load of clams is sighted from the village the factory whistle is blown to notify the people that they should come to work.

When the run boat arrives at the receiving dock, the clams are unloaded as quickly as possible. This is accomplished with very little labor by an endless-chain bucket conveyor. The clams are shoveled into a short, heavy, iron chute, which reaches the deck of the boat and is adjustable to the stage of the tide. The clams are gathered up by elongate V-shaped iron buckets and are carried overhead, about 10 feet above the dock, where they are deposited in a large wire-meshed cylinder set at an incline. The cylinder revolves in a tank of water and finally carries the cleansed clams to a chute that empties into iron cars similar to those used in oyster canneries. The dock is covered with a series of tracks and is equipped with a turntable that makes it possible to turn the cars at right angles when necessary.

Three cars at a time, loaded with clams, are pushed into the interior of the cannery and placed inside a large iron cylinder. The cylinder is then sealed by a massive iron door fitted with heavy lugs, after which the steam is turned on in order to kill the clams. The clams die quickly and the shells open and lose their liquid contents, which collects at the bottom of the long cylinder and is carried away by an underground porcelain-lined pipe, emptying into a large galvanized-iron tank set below the floor's level in another room. The liquid is collected from this tank for use in the various products.

After the clams are killed the cars containing them are rolled out of the cylinder. The meats are then removed from the shells, put into buckets, and dumped into a large spray and washing machine, which is used to thoroughly cleanse them of grit. The washer consists of a large cylinder built of heavy mesh galvanized wire, which revolves in a tank of water, and it also has a spiral track that gradually carries the clams to the exit. Upon leaving the washer the clams are deposited through a short chute upon a wide rubber belt conveyor, which looks like a table with a moving top. Four operators on each side of the conveyor sort the clams. Some of them pick out the small white clams while others select the large dark ones. The sorted clams are thrust into a short offset spout, placed beside each operator, through which they are deposited in buckets beneath. Since the clams are used for different preparations, as already explained, sorting is necessary.

Next to the sorting table lies the clam mincer, which is a large food chopper operated by electricity. The large dark clams, used for chowder and canned minced clams, are minced in this machine. The potato peeler is situated next. After peeling, the potatoes are diced by hand as are the other vegetables. Onions and seasoning are also prepared by hand.

The various cookers, retorts, filling machines, capping machines, etc., are similar to those used in any modern vegetable or fruit cannery. The chowder is cooked in a 400-gallon glass-lined iron cooking pot and is kept stirred by a glazed propeller that reaches nearly to the bottom of the pot. The canned whole clams are cooked in six large steam retorts, each of which has a capacity of 900 No. 2 cans. After the canned product has been cooled in a tank of water the cans are labeled, packed in boxes, and brought to the opposite end of the building for shipment. The cases of clam products leave the cannery on a ball-bearing declined roller track which delivers them to a freight boat to be carried to Key West for shipment via coastwise steamship.

The State of Florida levies various taxes on the catching and preparing of clams. Besides a tax of 2 cents per barrel on all clams removed from the waters of the State, taxes are payable each year on runboats, dredges, process kettles, etc. The shellfish laws are published in booklet form, and are obtainable from the shellfish commissioner, at Tallahassee, Fla.

The clam resources of southern Florida can bear considerably more fishing. The chief drawbacks at the present time to the further utilization of the product and the expansion of the industry are the inaccessibility of the beds to transportation lines and their remoteness from northern markets.

In the Northeastern States the quahaug has been gradually declining in abundance and rising in value. Along our North Atlantic coast the small clam beds have been far from adequate to keep pace with the ever-increasing demands for this popular mollusk in the fresh state. The large clam beds of the Ten Thousand Islands, Fla., however, are practically virgin and await development.

BIBLIOGRAPHY.[9]

FISHES AND FISHERIES.

ADAMS, A. C., and WILLIAM CONVERSE KENDALL.
1891. Report upon an investigation of the fishing grounds off the west coast of Florida. Bulletin, U. S. Fish Commission, Vol. IX, 1889 (1891), pp. 289–312. Washington.

BARBOUR, THOMAS.
1905. Notes on Bermudian fishes. Bulletin, Museum of Comparative Zoology, Vol. XLVI, No. 7, pp. 107–134, 4 pls. Cambridge.

BIGELOW, HENRY B., and WILLIAM W. WELSH.
1924. Fishes of the Gulf of Maine. Bulletin, U. S. Bureau of Fisheries, Vol. XL, 1924, Part I. Washington. [In press.]

BRICE, JOHN J.
1898. The fish and fisheries of the coastal waters of Florida. Report, U. S. Commissioner of Fish and Fisheries, 1896 (1898), pp. 263–342. Washington.

[9] This bibliography was prepared to include those publications that relate directly to the Florida fisheries or that will serve a useful purpose in amplifying the information given in this paper.

COBB, JOHN N.
1898. Possibilities for an increased development of Florida's fishery resources. Bulletin, U. S. Fish Commission, Vol. XVII, 1897 (1898), pp. 349–351. Washington.

COLLINS, J. W.
1887. Report on the discovery and investigation of fishing grounds, made by the Fish Commission steamer *Albatross* during a cruise along the Atlantic coast and in the Gulf of Mexico; with notes on the Gulf fisheries. Report, U. S. Commissioner of Fish and Fisheries, 1885 (1887), pp. 217–311, Pls. I–X. Washington.
1887a. Notes on the red-snapper fishery. Bulletin, U. S. Fish Commission, Vol. VI, 1886 (1887), pp. 299–300. Washington.

DETWILER, JOHN Y.
1898. Notes on the fishing industry of eastern Florida. Bulletin, U. S. Fish Commission, Vol. XVII, 1897 (1898), pp. 309–312. Washington.

DIAZ, JUAN VILARÓ.
1893. Algo sobre peces de Cuba con cierta extension a los de Puerto Rico y los Estados Unidos. 176 pp. Habana.

EARLL, R. EDWARD.
1883. The Spanish mackerel, *Cybium maculatum* (Mitch.); its natural history and artificial propagation, with an account of the origin and development of the fishery. Report, U. S. Commissioner of Fish and Fisheries, 1880 (1883), pp. 395–426, Pls. I–III. Washington.
1887. Eastern Florida and its fisheries. *In* The Fisheries and Fishery Industries of the United States, by George Brown Goode and associates, Sec. II, Pt. XIV, pp. 519–531. Washington.
1887a. The Spanish-mackerel fishery. *Ibid.*, Sec. V, Vol. I, Pt. VIII, pp. 545–552. Washington.
1887b. The mullet fishery. *Ibid.*, Sec. V, Vol. I, Pt. IX, pp. 553–582. Washington.

EIGENMANN, CARL H.
1890. The barracuda and the fishery for it. *In* Report on the fisheries of the Pacific coast of the United States, by J. W. Collins. Report, U. S. Commissioner of Fish and Fisheries, 1888 (1892), pp. 26–27. Washington.

EVERMANN, BARTON WARREN.
1898. The fish fauna of Florida. Bulletin, U. S. Fish Commission, Vol. XVII, 1897 (1898), pp. 201–208. Washington.

EVERMANN, BARTON WARREN, and WILLIAM CONVERSE KENDALL.
1900. Check list of the fishes of Florida. Report, U. S. Commissioner of Fish and Fisheries, 1899 (1900), pp. 35–103. Washington.

EVERMANN, BARTON WARREN, and MILLARD CALEB MARSH.
1902. The fishes of Porto Rico. Bulletin, U. S. Fish Commission, Vol. XX, Pt. 1, 1900 (1902), pp. 49–350, 52 pls., 112 text figs. Washington.

EVERMANN, BARTON W., and BARTON A. BEAN.
1898. The fisheries of Indian River, Fla. Report, U. S. Commissioner of Fish and Fisheries, 1896 (1898), pp. 223–262, pls. 23–59. Washington.

GOODE, GEORGE BROWN.
1877. Provisional catalogue of the fishes of Bermuda. 8 pp. Hamilton, Bermuda.
1882. The carangoid fishes of the United States—pompanoes, crevalles, amber fish, etc. Bulletin, U. S. Fish Commission, Vol. I, 1881 (1882), pp. 30–43. Washington.
1884. The food fishes of the United States. *In* The Fisheries and Fishery Industries of the United States, by George Brown Goode and associates, Sec. I, Pt. III, pp. 163–682. Washington.

GOODE, GEORGE BROWN, and TARLETON H. BEAN.
1884. Notes on some Florida fishes. Proceedings, U. S. National Museum, Vol. VII, 1884 (1885), pp. 42–47. Washington.

HARGREAVES, T. SIDNEY.
1904. The fishes of British Guiana. [An account of the food fishes.] 36 pp., illus. The Argosy Co. (Ltd.). Demerara.

HENSHALL, JAMES A.
1891. Report upon a collection of fishes made in southern Florida during 1889. Bulletin, U. S. Fish Commission, Vol. IX, 1889 (1891), pp. 371–389. Washington.
1895. Notes on fishes collected in Florida in 1892. Bulletin, U. S. Fish Commission, Vol. XIV, 1894 (1895), pp. 209–221. Washington.
1898. A plea for the development and protection of Florida fish and fisheries. Bulletin, U. S. Fish Commission, Vol. XVII, 1897 (1898), pp. 253–255. Washington.

JORDAN, DAVID STARR.
1880. Notes on a collection of fish from east Florida. Proceedings, U. S. National Museum, Vol. III, 1880 (1881), pp. 17–21. Washington.
1884. The fishes of the Florida keys. Bulletin, U. S. Fish Commission. Vol. IV, 1884, pp. 77–80. Washington.
1884a. List of fishes collected at Key West, Fla., with notes and descriptions. Proceedings, U. S. National Museum, Vol. VII, 1884 (1885), pp. 103–150. Washington.

JORDAN, DAVID STARR, and BARTON W. EVERMANN.
1896–1900. Fishes of North and Middle America. Bulletin, U. S. National Museum, No. 47, Pts. I–IV, 1896–1900, 3313 pp., 392 pls. Washington.

JORDAN, DAVID STARR, and CHARLES H. GILBERT.
1885. A review of the species of the genus Calamus. Proceedings, U. S. National Museum, Vol. VII, 1884 (1885), pp. 14–24. Washington.

JORDAN, DAVID STARR, and JOSEPH SWAIN.
1885. A review of the species of the genus Hæmulon. Proceedings, U. S. National Museum, Vol. VII, 1884 (1885), pp. 281–317. Washington.
1885a. A review of the American species of Epinephelus and related genera. *Ibid.*, pp. 358–410. Washington.
1885b. A review of the species of Lutjaninæ and Hoplopagrinæ found in American waters. *Ibid.*, pp. 427–474. Washington.

JORDAN, DAVID STARR, and JOSEPH C. THOMPSON.
1905. The fish fauna of the Tortugas Archipelago. Bulletin, U. S. Bureau of Fisheries, Vol. XXIV, 1904 (1905), pp. 229–256, 6 figs. Washington.

LA GORCE, JOHN OLIVER.
1921. Treasure house of the Gulf Stream. The National Geographic Magazine, Vol. XXXIX, No. 1, January, 1921, pp. 53–68. Washington.

MEEK, ALEXANDER.
1916. The migrations of fish. 427 pp., 128 diagrams and maps. London.

MEEK, SETH E., and SAMUEL F. HILDEBRAND.
1924. The marine fishes of Panama. Field Museum of Natural History, Zoological Series, Vol. XV, Parts I, II, and III. Chicago. [Parts II and III in press.]

MOORE, HENRY FRANK.
1919. Groupers: Fishes you should try, with recipes for cooking them, by Evelyn Spencer. U. S. Bureau of Fisheries Economic Circular No. 44. 8 pp., 1 text fig. Washington.

MOWBRAY, LOUIS L.
1922. Certain citizens of the warm sea. The National Geographic Magazine, Vol. XLI, No. 1, January, 1922, pp. 27–62, 16 pls., 18 figs. Washington.

MUSGRAVE, ANTHONY, Jr.
1881. Fishes and fishing [in Jamaica], to which is added "The fishes of Jamaica," by the late Richard Hill. Extracted from the Handbook of Jamaica for 1881. Pp. 121–137. Kingston, Jamaica.

NICHOLS, JOHN TREADWELL.
1912. Notes on Cuban fishes. Bulletin, American Museum of Natural History, Vol. XXXI, Art. XVIII, pp. 179–194. New York.
1921. Interesting citizens of the Gulf Stream. The National Geographic Magazine, Vol. XXXIX, No. 1, January, 1921, pp. 69–84, 8 pls., 11 figs. Washington.

PHILLIPS, BARNET.
1884. Some notes on the mullet fisheries. Bulletin, U. S. Fish Commission, Vol. IV, 1884, pp. 135–137. Washington.

PIERCE, H. D.
1884. Notes on the bluefish, mortality of Florida fishes, etc. Bulletin, U. S. Fish Commission, Vol. IV, 1884, pp. 263–266. Washington.
POEY, FELIPE.
1883. List of food fishes brought from Key West, Fla., into the markets of Habana. Bulletin, U. S. Fish Commission, Vol. II, 1882 (1883), p. 118. Washington.
REGAN, C. TATE.
1920. Report on the fishes of the Colonies. Colonial Reports—Miscellaneous, No. 92, 15 pp. London.
SMITH, HUGH MCCORMICK.
1907. The fishes of North Carolina. North Carolina Geological and Economic Survey, Vol. II, 1907, 453 pp., 21 pls., 188 figs. Raleigh.
STEARNS, SILAS.
1887. Some of the fisheries of western Florida. Bulletin, U. S. Fish Commission, Vol. VI, 1886 (1887), pp. 465–467. Washington.
1887a. The fisheries of the Gulf of Mexico. *In* The Fisheries and Fishery Industries of the United States, by George Brown Goode and associates, Sec. II, Pt. XV [Western Florida], pp. 533–568. Washington.
1887b. The red-snapper fishery and the Habana market fishery of Key West, Florida. *Ibid.*, Sec. V. Vol. I, Pt. X, pp. 585–592. Washington.
WARREN, ANDREW F.
1898. The red-snapper fisheries: Their past, present, and future. Bulletin, U. S. Fish Commission, Vol. XVII, 1897 (1898), pp. 331–335. Washington.
WILCOX, WILLIAM A.
1900. Notes on the foreign fishery trade and local fisheries of Porto Rico. Report, U. S. Commissioner of Fish and Fisheries, 1899 (1900), pp. 1–34, pls. 1–6. Washington.
1904. The fisheries and fish trade of Porto Rico in 1902. Report, U. S. Commissioner of Fish and Fisheries, 1902 (1904), pp. 367–395. Washington.

TURTLES.

DITMARS, RAYMOND LEE.
1907. The reptile book. 472 pp., illus. [The sea turtles, pp. 4–10]. New York.
1910. Reptiles of the world. 373 pp., illus. [Sea Turtles, pp. 43–49]. New York.
MUNROE, RALPH M.
1898. The green turtle and the possibilities of its protection and consequent increase on the Florida coast. Bulletin, U. S. Fish Commission, Vol. XVII, 1897 (1898), pp. 273–274. Washington.
TRESSLER, DONALD K.
1923. Marine products of commerce. Chapter 32, Marine turtles and terrapins, pp. 596–606. New York.
TRUE, FREDERICK WILLIAM.
1884. The useful aquatic reptiles and batrachians of the United States. *In* The Fisheries and Fishery Industries of the United States, by George Brown Goode and associates, Sec. I, Pt. II. (Tortoises, turtles, and terrapins, pp. 147–158.) Washington.
1887. The turtle and terrapin fisheries. *Ibid.*, Sec. V, Vol. II, pp. 493–503. Washington.

CRUSTACEANS.

CRAWFORD, DONALD R., and W. J. J. DE SMIDT.
1922. The spiny lobster (*Panulirus argus*) of southern Florida: Its natural history and utilization. Bulletin, U. S. Bureau of Fisheries, Vol. XXXVIII, 1921–22 (1923), pp. 281–310, 14 figs. Washington.

RATHBUN, RICHARD.
1884. Crustaceans, worms, radiates, and sponges. *In* The Fisheries and Fishery Industries of the United States, by George Brown Goode and associates, Sec. I, Pt. V. (The stone crab (*Menippe mercenarius* Gibbes), pp. 772–774.) Washington.
1887. The crab, lobster, crayfish, rock lobster, shrimp, and prawn fisheries. *In* The Fisheries and Fishery Industries of the United States, by George Brown Goode and associates, Sec. V, Vol. II, Pt. XXI. (The stone crab, pp. 650–651.) Washington.
1887a. *Ibid.* (The rock-lobster [spiny lobster] fishery of California, pp. 798–799.) Washington.
SMITH, HUGH MCCORMICK.
1895. Notes on a reconnaissance of the fisheries of the Pacific coast of the United States in 1894. Bulletin, U. S. Fish Commission, Vol. XIV, 1894 (1895). (The spiny lobster or crawfish (*Panulirus interruptus*), pp. 280–281.) Washington.
TRESSLER, DONALD K.
1923. Marine products of commerce. (American spiny lobster fishery, pp. 593–594.) New York.

SPONGES.

COBB, JOHN N.
1904. The sponge fishery of Florida in 1900. Report, U. S. Commissioner of Fish and Fisheries, 1902 (1904), pp. 161–175, pls. 6–9. Washington.
COTTE, JULES.
1910. Sponge culture. Bulletin, U. S. Bureau of Fisheries, Vol. XXVIII, Pt. I, 1908 (1910), pp. 587–614. Washington.
FLÉGEL, CHARLES.
1910. The abuse of the scaphander in the sponge fisheries. Bulletin, U. S. Bureau of Fisheries, Vol. XXVIII, Pt. I, 1908 (1910), pp. 513–543. Washington.
MOORE, HENRY FRANK.
1910. The commercial sponges and the sponge fisheries. Bulletin, U. S. Bureau of Fisheries, Vol. XXVIII, Pt. I, 1908 (1910), pp. 399–511, Pls. XXVIII–LXVI, 4 text figs. Washington.
1910a. A practical method of sponge culture. *Ibid.*, pp. 545–585, Pls. LXVII–LXXVI, 7 text figs. Washington.
1923. Commercial sponges. *In* Marine products of commerce, by Donald K. Tressler and collaborators, chapter 36, pp. 668–691. New York.
MUNROE, RALPH M.
1896. Account of sponge-cultural experiments in Biscayne Bay. Report, U. S. Commissioner of Fish and Fisheries, 1895 (1896), pp. 187–188. Washington.
RATHBUN, RICHARD.
1884. Crustaceans, worms, radiates, and sponges. *In* The Fisheries and Fishery Industries of the United States, by George Brown Goode and associates, Sec. I, Pt. V. (The sponges, pp. 843–850.) Washington.
1887. The sponge fishery and trade. *Ibid.*, Sec. V, Vol. II, pp. 819–841. Washington.
RUGE, J. G.
1889. The sponge fisheries of Florida. Bulletin, U. S. Fish Commission, Vol. VII, 1887 (1889), pp. 22–24. Washington.
SMITH, HUGH MCCORMICK.
1898. The Florida commercial sponges. Bulletin, U. S. Fish Commission, Vol. XVII, 1897 (1898), pp. 225–240, pls. 12–31. Washington.
1901. Notes on the Florida sponge fishery in 1899. Bulletin, U. S. Fish Commission, Vol. XIX, 1899 (1901), pp. 149–151. Washington.
U. S. COMMISSIONER OF FISHERIES.
1902. [Sponge-planting experiments.] Report, U. S. Commissioner of Fish and Fisheries, 1901 (1902), pp. 122–123. Washington.
1904. *Ibid.*, 1902 (1904), pp. 125–127.
1905. *Ibid.*, 1903 (1905), pp. 86–88.
1907. [Experiments in sponge culture.] Report, U. S. Commissioner of Fish and Fisheries, 1905 (1907), p. 22. Washington.

U. S. COMMISSIONER OF FISHERIES—Continued.
1908. *Ibid.*, 1906 (1908), p. 13.
1909. [Experiments in sponge culture.] Report, U. S. Bureau of Fisheries, 1907 (1909), pp. 11–12. Washington.
1910. *Ibid.*, 1908 (1910), p. 10.
1911. *Ibid.*, 1909 (1911), pp. 14–15.
1911a. *Ibid.*, 1910 (1911), p. 17.
1911b. [The Florida sponge law.] *Ibid.*, 1910 (1911), pp. 37–38.
1913. *Ibid.*, 1911 (1913), p. 52.
1914. *Ibid.*, 1913 (1914), pp. 68–69.
WILSON, HENRY V.
1898. On the feasibility of raising sponges from the egg. Bulletin, U. S. Fish Commission, Vol. XVII, 1897 (1898), pp. 241–245. Washington.

CLAMS.

BELDING, DAVID L.
1909. A report upon the mollusc fisheries of Massachusetts. 243 pp., pls., charts. Boston.
INGERSOLL, ERNEST.
1887. The oyster, scallop, clam, mussel, and abalone industries. *In* The Fisheries and Fishery Industries of the United States, by George Brown Goode and associates, Sec. V, Vol. II, Pt. XX. (The clam fisheries, pp. 581–615.) Washington.
KELLOGG, JAMES LAWRENCE.
1901. The clam problem and clam culture. Bulletin, U. S. Fish Commission, Vol. XIX, 1899 (1901), pp. 39–44, 1 pl. Washington.
1910. Shell-fish industries. 361 pp. (The hard clam, pp. 321–332.) New York.
KRAUSE, A. K.
1903. Preliminary report on the habits and life-history of the quahaug (*Venus mercenaria*). Twenty-third Annual Report, Rhode Island Commissioners of Inland Fisheries, January Session, 1903, pp. 50–54, fig. 19. Providence.
MOORE, HENRY FRANK.
1898. Notes on clam culture. *In* A Manual of Fish-Culture, by John J. Brice. Report, U. S. Commissioner of Fish and Fisheries, 1897 (1898), pp. 339–340. Washington.
SCHROEDER, WILLIAM C.
1920. Clam resources of the Ten Thousand Islands, Fla. U. S. Bureau of Fisheries Economic Circular No. 46. 5 pp. Washington.
TRESSLER, DONALD K.
1923. Marine products of commerce. Chapter 28, The clam industry of the United States, pp. 532–547. New York.

STATISTICAL REPORTS.

ALEXANDER, A. B.
1905. Statistics of the fisheries of the South Atlantic States, 1902. Report, U. S. Commissioner of Fish and Fisheries, 1903 (1905), pp. 343–410. Washington.
1905a. Statistics of the fisheries of the Gulf States, 1902. *Ibid.*, pp. 411–481.
1905b. Report on statistics and methods of the fisheries. Report, U. S. Bureau of Fisheries, 1904 (1905), pp. 121–162. Washington.
BRICE, JOHN J.
1898. The fish and fisheries of the coastal waters of Florida. Report, U. S. Commissioner of Fish and Fisheries, 1896 (1898), pp. 263–342. Washington.
COLLINS, J. W.
1892. Statistical review of the coast fisheries of the United States. Report, U. S. Commissioner of Fish and Fisheries, 1888 (1892). (Florida, pp. 361–364.) Washington.
COLLINS, J. W., and HUGH M. SMITH.
1893. A statistical report on the fisheries of the Gulf States. Bulletin, U. S. Fish Commission, Vol. XI, 1891 (1893), pp. 93–184. Washington.

RADCLIFFE, LEWIS.
1921. Fishery industries of the United States. Report of the division of statistics and methods of the fisheries, for 1919. Appendix X, Report, U. S. Commissioner of Fisheries, 1919 (1921). (Fisheries of the Gulf States in 1918, pp. 129–191.) Washington.
1922. Fishery industries of the United States. Report of the division of statistics and methods of the fisheries, for 1920. Appendix V, Report, U. S. Commissioner of Fisheries, 1921 (1922). (Fisheries of the South Atlantic States in 1918, pp. 59–120.) Washington.

SMITH, HUGH M.
1893. Report on the fisheries of the South Atlantic States. Bulletin, U. S. Fish Commission, Vol. XI, 1891 (1893), pp. 271–356, Pls. XLIII–LXXIV. Washington.

TOWNSEND, C. H.
1900. Statistics of the fisheries of the Gulf States. Report, U. S. Commissioner of Fish and Fisheries, 1899 (1900), pp. 105–169. Washington.
1900a. Statistics of the fisheries of the South Atlantic States. *Ibid.*, pp. 171–227.

FLORIDA STATE REPORTS.

1899. Report of the Fish Commission of the State of Florida, for 1898. 7 pp. Tallahassee.
1901. Report of the Fish Commission of the State of Florida, for 1899–1900. 8 pp. Tallahassee.
1903. Report of the Fish Commission of the State of Florida, for 1901–2. 16 pp. Tallahassee.
1905. Report of the Fish Commission of the State of Florida, for 1903–4. 12 pp. Tallahassee.
1915. First Biennial Report of the Shellfish Division of the Department of Agriculture of the State of Florida, for the years 1913 and 1914. 69 pp. Tallahassee.
1917. Second Biennial Report, Shellfish Division of the Department of Agriculture of the State of Florida, for the years 1915 and 1916. 85 pp. Tallahassee.
1919. Third Biennial Report of the Florida Shellfish Commission. Years 1917–1918. 103 pp. Tallahassee.
1922. Fourth Biennial Report of the Shellfish Commission. Years 1919–1920. 39 pp. Tallahassee.
1923. Fifth Biennial Report of the Shellfish Division of the Department of Agriculture of the State of Florida, for the years 1921–1922. 83 pp. Tallahassee.

GENERAL.

TRESSLER, DONALD K.
1923. Marine products of commerce. 762 pp., 257 figs. New York.